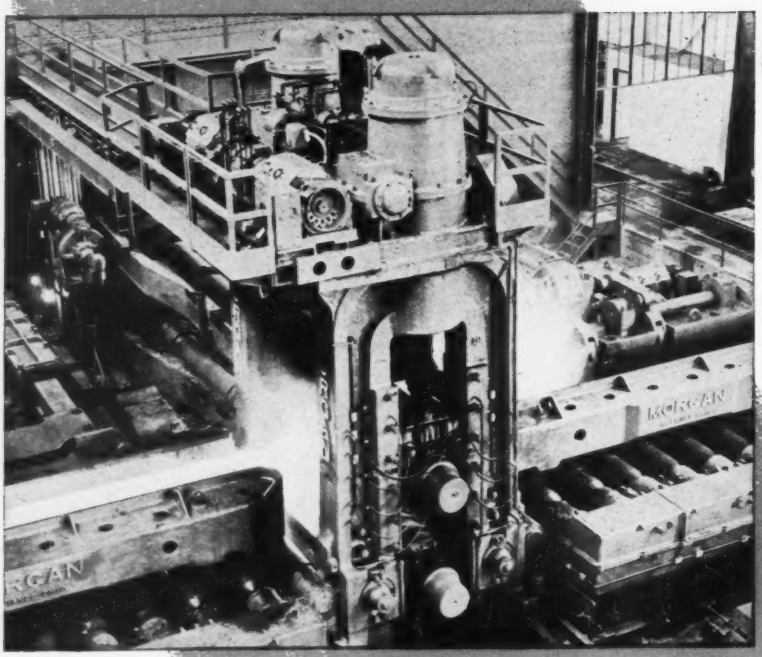
AUGUST, 1950
Vol. 6 — No. 4

Lubrication ENGINEERING

JOURNAL OF THE AMERICAN SOCIETY OF LUBRICATION ENGINEERS

STEEL MILLS DEPEND ON Trabon FOR SAFE BEARING LUBRICATION!



Shown is a Trabon Automatic Lubricating System at work on a Morgan 40"—2 High Reversing Blooming Mill in the plant of a large steel producer.

No neglected or underlubricated bearings here! No worn-out bearings due to lack of lubrication! No down time for replacements or repair! Instead, schedules stepped up, production increased, operating and maintenance costs kept at a minimum.

Trabon systems are sealed—there are no exposed moving parts. Operate efficiently when buried in dust, water, dirt, or grime. Trabon has ONE indicator at the pump, assuring a measured amount of lubricant to each bearing.

Trabon oil and grease systems are job proved in over 20 years' service on thousands of operations where bearings require positive, dependable lubrication.

Write or phone your Trabon man today.

TRABON ENGINEERING CORPORATION
1814 EAST 40th STREET
CLEVELAND 3, OHIO

There are more TRABON AUTOMATIC LUBRICATING SYSTEMS in operation than all other makes!

Trabon

OIL AND GREASE SYSTEMS

SKILSAW CUTS DOWN-TIME AND TOOL GRINDS 75% with Stuart's SPEEDKUT

Multi-Purpose Cutting Fluid Saves on Machining Worm Gears

MATERIAL: Stressproof No. 2
MACHINE: Acme Gridley 2" RB-6
SPEED: Spindle speed 443 (116 pos. per hr.) Surface feet 123
FEED: Form Tool .0012 (.499 core drill .0064 feed)
TOOL LIFE: 12 hours between grinds
CUTTING FLUID: 1 part SpeedKut B to 6 parts paraffin oil
COST APPRAISAL: Savings resultant equal 75% less machine down-times; also 75% less tool grindings
NOTE: Machine is now made available to more production within its capacity.

THE FIGURES above speak for themselves. Skilsaw, Inc., noted as being one of the most progressive and cost-conscious manufacturers in the metal-working field, selected Stuart's multi-purpose Speed-Kut B for three operations (automatic screw machine, spline broaching, hobbing) on worm gears after placing it in direct competitive tests with other cutting fluids. SpeedKut B is applied straight on the broach while a 6 to 1 dilution is used on the other two operations.

Your Stuart Representative's business is COST REDUCTION. Ask him to call and show you how he can help you.

WRITE FOR D. A. Stuart's booklet, "Cutting Fluid Facts" . . . a guide to better machining.

D.A. Stuart Oil CO.

2729-53 South Troy Street, Chicago 23, Illinois

Lubrication ENGINEERING

VOL. AUGUST, 1950 No. 4

In This Issue

The Editor's Page 157
Compressor Lubrication—K. L. Hollister 158
Studies of the Load-Carrying Capacity of Sleeve Bearings—C. M. Allen and K. A. Davis 161
Fundamentals of Cutting Fluid Action—M. Eugene Merchant 163
"The Lubrication Engineer"—His Establishment and Development in Industry—G. D. Jordan 168
New Products and Equipment 172
News of the Sections 173
Current Literature 176
Patent Abstracts, Oils and Lubricants 177
Section Officers 188
Advertisers' Index 192

Special Features:

1951 Convention Hi-Lites ... 171

Book Reviews 179
Cover Story 189
Personals 189

LUBRICATION ENGINEERING
Official Publication of the American Society of Lubrication Engineers
343 S. Dearborn Street, Chicago 4, Ill.

Editor ..... BURGESS H. JENNINGS, Northwestern Technological Institute
Managing Editor ..... P. F. LEONARD
Editorial Committee ..... W. H. MILLETT, W. T. EVERITT, Carbide and Carbon Chemicals Division, Eastman Kodak Company
Business Manager ..... W. F. LEONARD

OFFICERS OF THE AMERICAN SOCIETY OF LUBRICATION ENGINEERS

D. F. HOLLINGSWORTH, Wilmington, Del., President
C. E. SCHMITZ, Chicago 13, Ill., Vice-President At Large
W. F. LEONARD, Chicago 4, Ill., Secretary
O. L. MAAG, Canton 6, Ohio, Treasurer

Regional Vice-Presidents
A. F. BREWER, Eastern, New York 17, N. Y.
M. E. MERCHANT, Mid-Western, Cincinnati 9, Ohio
G. A. ZAMBONI, Western, Los Angeles 46, Cal.

Directors
JOHN BOYD, East Pittsburgh, Pa.
W. E. CAMPBELL, Murray Hill, N. J.
E. CRANKSHAW, Cleveland 10, Ohio
D. D. FULLER, New York 27, N. Y.

Directors
R. A. KRAUS, Chicago, Ill.
T. A. MARSHALL, Hamilton, Ont., Can.
FRANK ROSS, Philadelphia 33, Pa.
V. A. RYAN, Baltimore 3, Md.

C. L. POPE, Rochester 4, N. Y., Chairman, Presidential Council

Subscription — $4.00 annually. Single copies — $.75. Published bi-monthly.
Copyright 1950 by the American Society of Lubrication Engineers.
Printed in Cincinnati, Ohio, by S. Rosenthal & Co., Inc.
The A.S.L.E. will not be responsible for statements or opinions advanced in its meetings or printed in its publications.
Advertising and Editorial Offices CHICAGO: 343 S. Dearborn St., Chicago 4, Ill., Webster 9-3848.

MADISON-KIPP *Fresh Oil* LUBRICATORS

Fresh Oil... BY THE MEASURED DROP
Madison-Kipp LUBRICATORS
Fresh Oil DROP BY DROP UNDER PRESSURE FROM THE MODEL
MADISON-KIPP LUBRICATOR
MADISON-KIPP CORPORATION
MODEL SVD LUBRICATORS
Madison-Kipp MODEL 50 LUBRICATORS

. . . provide the most dependable method of lubrication ever developed

Oil under pressure fed drop by drop from a Madison-Kipp Lubricator will definitely increase the production potential for years to come when applied as original equipment on new machine tools, work engines, and compressors. There are six popular models for every application. Write for special engineering data for your particular requirement.

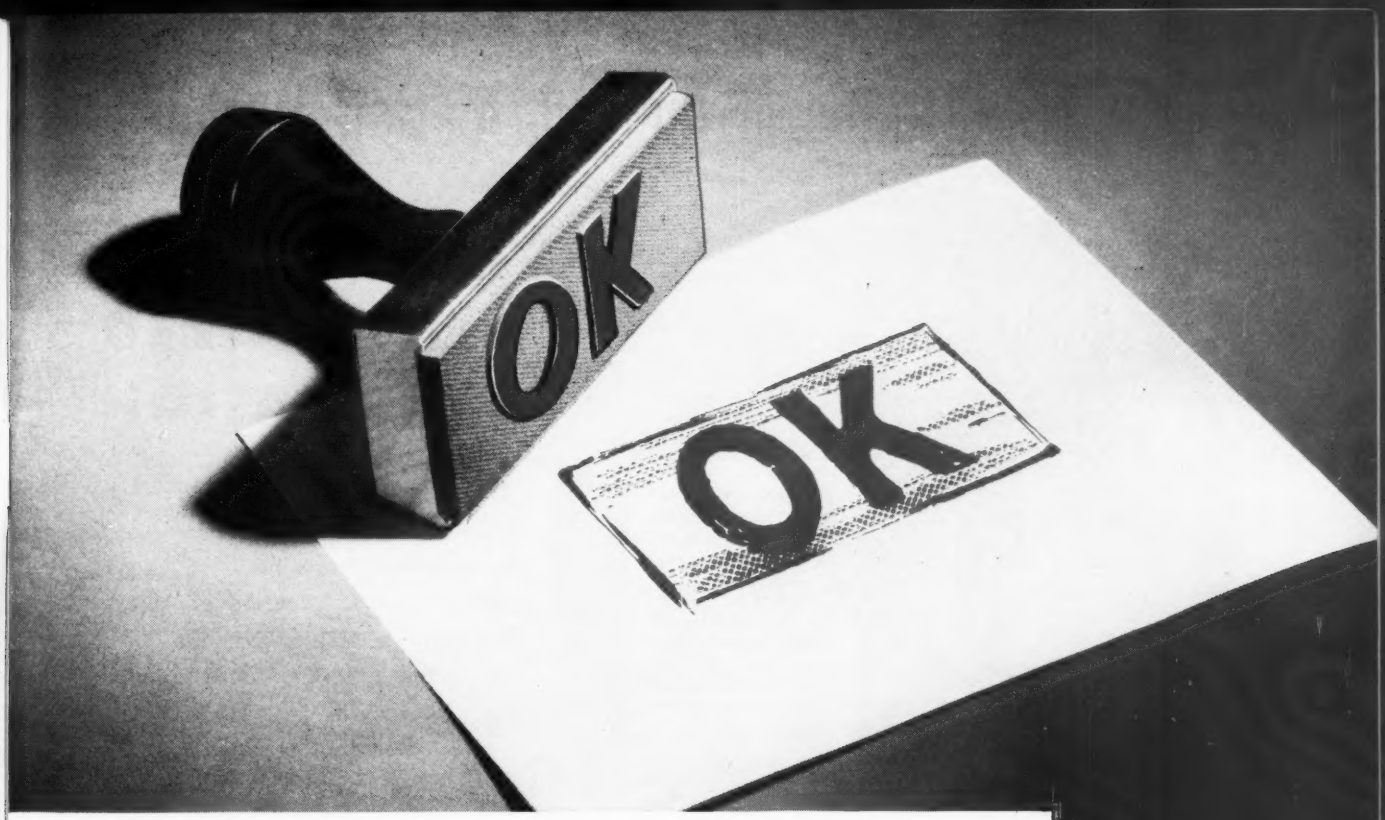
MADISON-KIPP CORPORATION

223 WAUBESA STREET, MADISON 10, WIS., U.S.A.

ANCIENS ATELIERS GASQUY, 31 Rue du Marais, Brussels, Belgium, sole agents for Belgium, Holland, France, and Switzerland.

WM. COULTHARD & CO. Ltd., Carlisle, England, sole agents for England, most European countries, India, Australia, and New Zealand.

- *Skilled in* DIE CASTING *Mechanics*
- *Experienced in* LUBRICATION *Engineering*
- *Originators of Really High Speed* AIR TOOLS



Operators Know

CIMCOOL IS TOPS!

Quiz the metal cutting operator who uses this revolutionary cutting fluid. He'll tell you that Cimcool° is the biggest working improvement in years.

Here's *why* Cimcool is superior to old-fashioned cutting fluids. It's a *chemical emulsion* incorporating a radically new and different principle in cutting fluids. It replaces all water emulsions and all but a few highly compounded specialty oils.

And here's *how* Cimcool makes jobs better. It's clean to work with, doesn't soil hands or clothes and contains no skin irritants. Cimcool leaves no hazardous slippery film on the hands, machine, work or floor. It cools so fast that tools and chips actually stay cool to the touch. And Cimcool virtually eliminates rancidity and foul odors—*even in the hottest weather.*

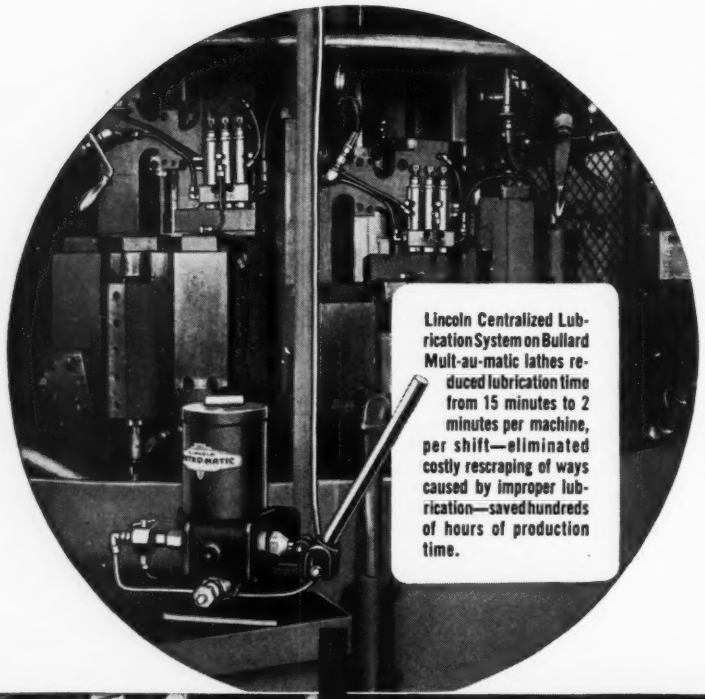
We honestly believe one test run will convince you. For a demonstration in one of your own machines, just write us and we'll have one of our Cincinnati Milling-trained machinists call on you—without cost or obligation. Or if you prefer, send for our free booklet "Cimcool Gives the Answers." Address, Sales Manager, Cincinnati Milling Products Division, The Cincinnati Milling Machine Company, Cincinnati 9, Ohio.

°Trade Mark Reg. U.S. Pat. Off.

A Production-Proved Product of
THE CINCINNATI MILLING MACHINE CO.

for 85% OF ALL METAL CUTTING JOBS

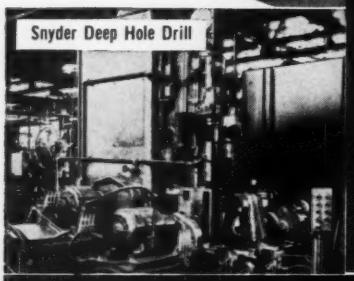
"Since Standardizing Lubrication Methods with *Lincoln* CENTRALIZED LUBRICATION SYSTEMS



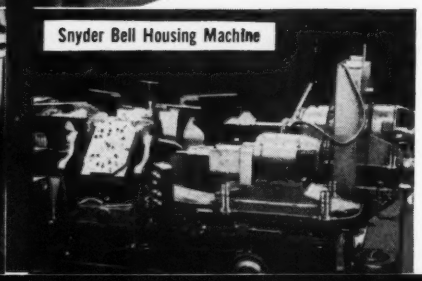
Lincoln Centralized Lubrication System on Bullard Mult-au-matic lathes reduced lubrication time from 15 minutes to 2 minutes per machine, per shift—eliminated costly rescraping of ways caused by improper lubrication—saved hundreds of hours of production time.

we eliminated many costly maintenance problems . . . saved production costs . . . and have not had a single case of machine failure due to lack of lubrication."

—As reported by the Master Mechanic of a prominent industrial manufacturer.

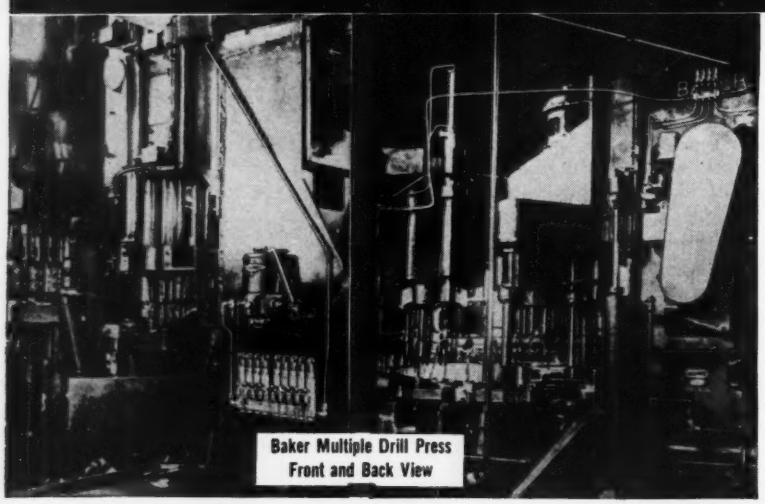


Snyder Deep Hole Drill



Snyder Bell Housing Machine

Lincoln Centralized Lubrication Systems eliminate guesswork and old-fashioned methods. Instead, each and every bearing requiring grease or oil receives the right lubricant, in the right quantity, at the right time. Precisely measured shots of lubricant are delivered to every rotating, sliding, or reciprocating part at predetermined time intervals.



Baker Multiple Drill Press Front and Back View

This company's Preventive Maintenance Program includes installation of Lincoln Centralized Lubrication Systems on the production machinery illustrated. Close manufacturing tolerances require extremely close fitted bearings on these machines necessitating measured applications of oil to all bearings at frequent, predetermined intervals.

Lincoln's lubrication specialists will work with you, and recommend the time and money saving Centralized Lubrication System to meet your requirements. Write for the name of your nearby Distributor.

Distributed Nationally Through Leading Industrial Distributors . . . Located in All Principal Cities.

• • • PIONEER BUILDERS
LINCOLN SAINT LOUIS
LUBRICATING EQUIPMENT • • •

SEE OUR CATALOG IN SWEET'S

LINCOLN ENGINEERING COMPANY
5743 Natural Bridge, St. Louis 20, Mo.

A Lubricant that Works from sub 0 to 3000 plus

ORDINARY lubricants gum up at extremely low temperatures or break down at extremely high temperatures . . . but not Acheson's specially processed **"dag"** colloidal graphite!

This versatile material is dispersed in organic and inorganic carriers for positive transmission to the zone of lubrication . . . for effective concentration at those points . . . for friction-fighting that can't be beat!

"dag" colloidal graphite is unique in its combination of properties and uses. It is very slippery and extremely durable, anti-corrosive, gas adsorbent, chemically inert and, of course, highly resistant to heat.

In deep piercing you get smooth forgings, close tolerances and reduced wear on dies. In casting and mold stripping you get smooth surfaces, clean parting, fewer rejects; and additional mold life.

In forging you minimize scaling and sticking, improve finish, lengthen die life.

In stretch-forming you reduce tearing and rippling. In wire-drawing you get uniform diameter, better finish and greatly extended die life.

Brass, bronze, aluminum, magnesium, carbon steel and stainless steel . . . wherever your fabrication problems are friction and heat . . . **"dag"** colloidal graphite reduces the one and resists the other.

The NEW Acheson Bulletin #426 on the Use of **"dag"** Colloidal Graphite in Metalworking operations is just off the press . . . a copy is ready for you if you will fill in and mail the coupon.

dag COLLOIDAL GRAPHITE
for Metalworking Operations

A

Acheson Colloids is equipped to do custom disintegrating, dispersing, and stabilizing of solids in a wide variety of vehicles. If you are in need of this type of service, tell us about it. We may be able to help you.

ACHESON COLLOIDS CORPORATION
Port Huron, Michigan

☐ Send me the NEW Metalworking Bulletin #426

☐ Send an Acheson engineer

NAME.....

COMPANY.....

STREET.....

CITY.....ZONE.....

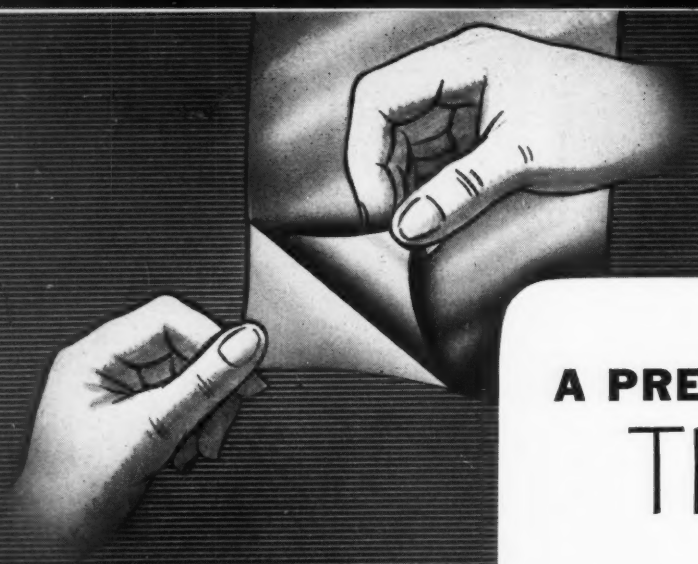
STATE.....

K-12

dag DISPERSIONS®

Acheson Colloids Corporation, Port Huron, Michigan

. . . also Acheson Colloids Limited, London, England

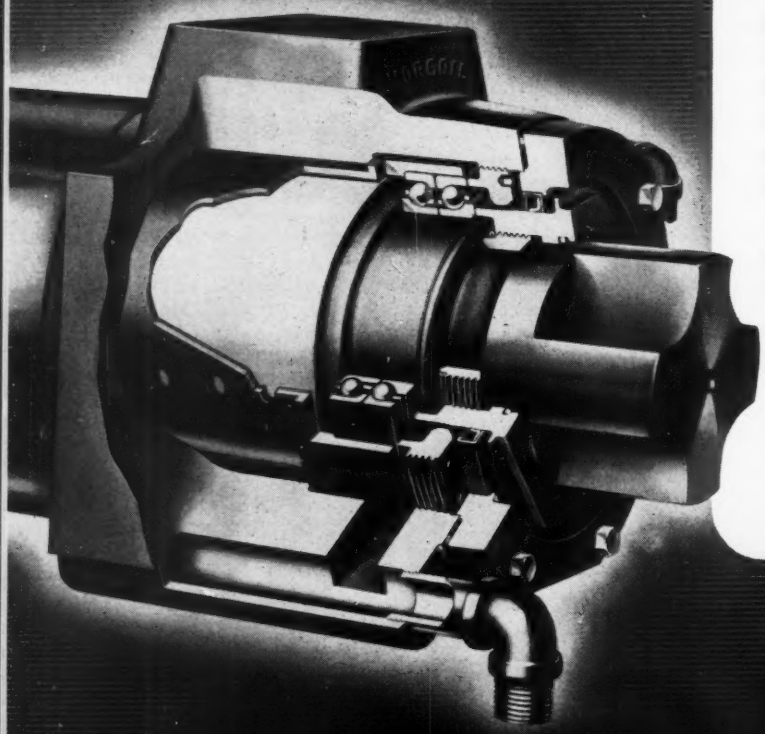


A PRETTY THIN STORY

We're speaking of rolling aluminum. The thinner you roll it, the further it goes, the wider your market possibilities.

Morgoil Roll Neck Bearings have proved to be a mighty important factor in rolling aluminum thin. Some mills are rolling it down to .00025" at a very fast clip and holding it within minute tolerances. This requires the accuracy and precision found *only* in Morgoils.

This same precision is also producing remarkable results in the rolling of light gauge copper, brass and steel.



MORGAN CONSTRUCTION CO.
WORCESTER, MASSACHUSETTS

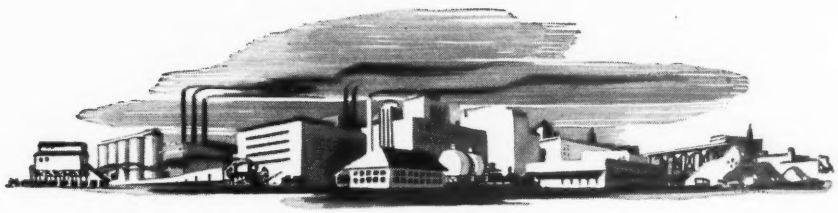
English Representative
International Construction Co.
56 Kingsway, London, W. C. 2, England

LE-8

MORGAN
WORCESTER
ROLLING MILLS - MORGOIL BEARINGS
WIRE MILLS - GAS PRODUCERS - AIR EJECTORS
REGENERATIVE FURNACE CONTROL

MORGOIL
ROLL NECK BEARINGS

How to spend $391.25 once and *Save $2160 Every Year!*



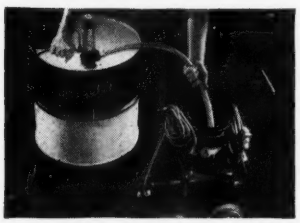
This is the actual experience of a Harrisburg Pa. firm* that stopped the kind of profit loss which may be hidden in YOUR plant, too!

In a material handling survey, lubricating of machines came in for its share of attention. The head of production called in an Alemite Lubrication Engineer to help him spot possible ways to cut costs. They found a way to lubricate machines that added 30 minutes more production daily. The total investment in Alemite equipment was $391.25! The saving in production time—in addition to a 60% reduction in lubricant used—comes to $2160 a year!

**Name on request*

No matter what size or type of plant you operate, Alemite can show you dozens of examples of amazing savings through more efficient handling of petroleum products. These are facts which you can readily confirm in your own time studies. Contact your local Alemite Industrial Distributor now. Or send for free booklet, "11 Ways to Cut Production Costs." Simply attach coupon below to your letterhead. Alemite, Dept. P-80, 1850 Diversey Parkway, Chicago 14, Ill.

Alemite Cuts Costs 3 Ways



1. ***In Transferring Lubricants...*** by eliminating mess, expensive contamination—and cutting man hours 63% for every 100 pounds of lubricant transferred.

2. ***In Loading Grease Guns . . .*** by saving 3¾ man hours for every 100 pounds of lubricant loaded into hand guns.

3. ***In Applying Lubricants . . .*** by saving up to 23.9 man hours for every 100 pounds of lubricant applied to bearings.

ALEMITE

MEANS EVERYTHING FOR LUBRICATION

1. Methods 2. Lubricants 3. Equipment

Another Product of Stewart-Warner

FREE! New Booklet—
"11 Ways to Cut Production Costs"...
(simply attach to your letterhead)

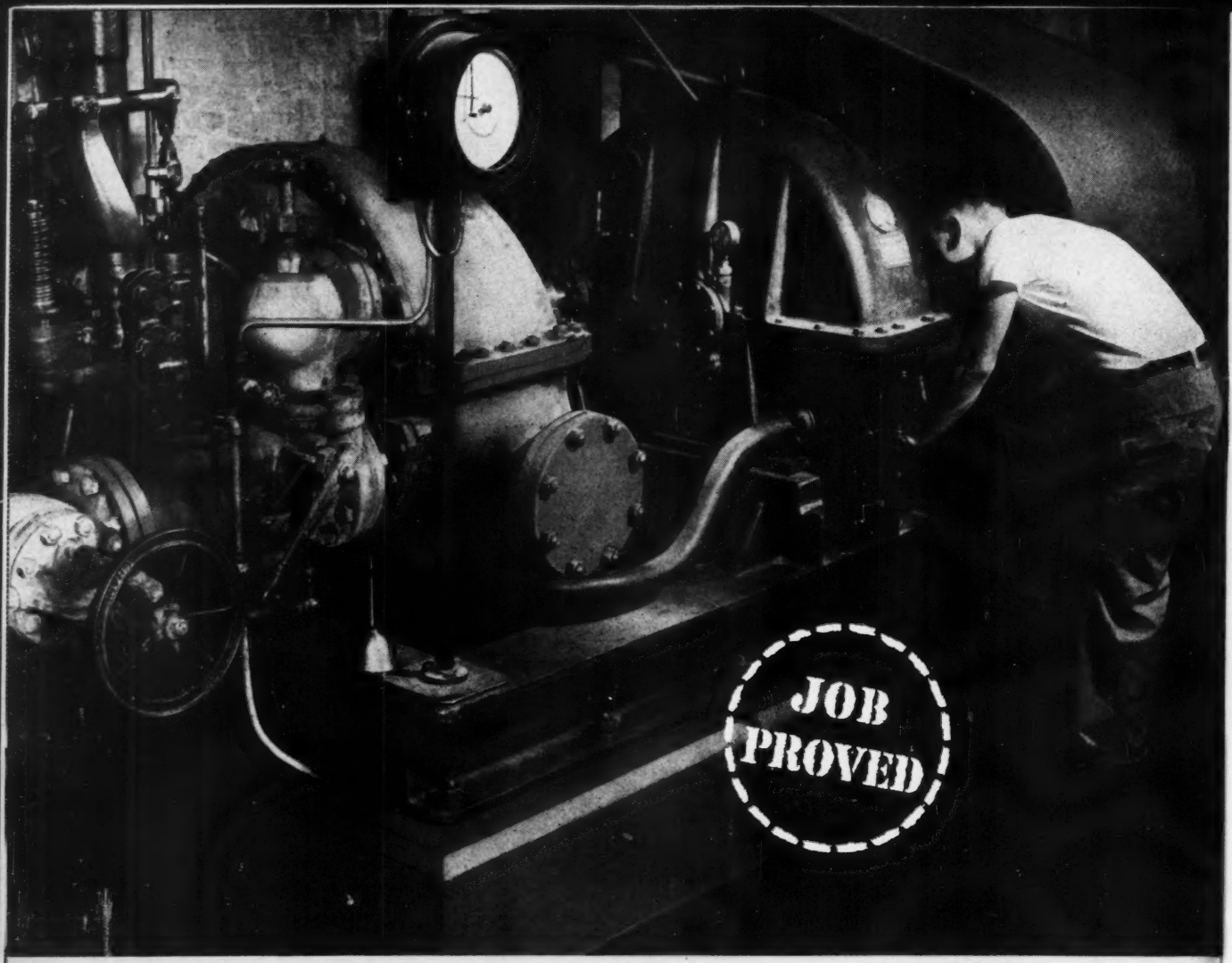
Alemite, Dept. P-80
1850 Diversey Parkway, Chicago 14, Ill.

Please send me without charge or obligation your booklet "11 Ways to Cut Production Costs."

*Name*_____

*Company*_____

*City*_____ *State*_____



SUNVIS 900 OILS REDUCE COSTS 25%

Papermaker Gets Maximum Equipment Protection, Extra Long Service, from Superior Turbine Lubricants

In a large paper mill, eight steam turbines drive paper machines and pumps, and generate power for ventilating equipment. Ten years ago the mill began lubricating these turbines with a "Job Proved" Sun oil. They gave unfailing service with remarkably low oil and maintenance costs.

Four years ago, when Sunvis "900" Oils first became available, the Sun representative serving the mill saw an opportunity to effect even greater economy. He suggested that the medium-priced Sun oils in use be replaced by the more costly Sunvis "900" Oils. He knew that these modern, fortified lubricants—*more costly* on a per-gallon basis—would prove *less costly* through the years because of their remarkably long life. His suggestion was followed.

The Sunvis "900" Oils have fully justified this confidence, saving the mill 25% or more on lubrication costs. Furthermore, the papermaker knows his equipment—running or idle—is fully protected from rust and corrosion.

Sunvis "900" Oils are *good for the life of your production equipment.* Coupled with the know-how of the Sun representative who calls on you, they are good for your pocketbook, too. For more information, send for a copy of the illustrated booklet "Sunvis '900' Oils". Write Department L-8.

SUN OIL COMPANY • ***Philadelphia 3, Pa.***
In Canada: Sun Oil Company, Ltd.
Toronto and Montreal

SUN PETROLEUM PRODUCTS

"JOB PROVED" IN EVERY INDUSTRY

SUNOCO®

THE EDITOR'S PAGE

Indianapolis Race

The Memorial Day 500-mile race at Indianapolis, which is now past history, ended this year before the 500 miles were completed because the rain and slippery track made high-speed driving with any degree of safety impossible. However, the 300 miles that were run pointed out some things which are worthy of comment. In former years, few of the cars lasted for more than a small fraction of the run before mechanical failure of some sort set in. The year 1950 was an exception in this regard. The answer to this is obvious; better construction, precision machining, accurate fit of parts, better metallurgical application and finally effective lubrication. Few realize the leading part played by lubrication in this event.

New lubricants have had to be developed to suit the high temperatures and extreme bearing loads for an endurance test such as this speedway race. The research projects of the oil companies and private research laboratories have paid off in better products. The benefits and improvements discovered are not confined to the automotive industry, but can meet other industrial demands, some of which present equally strenuous and exacting requirements.

More than passing interest might rest in the fact that the 1950 race was won with a car sponsored by a lubricant producer. To most of us, it is not important who wins the race. To us the spirit of competition is important, and what has gone into the manufacture and operation of a car that can win this gruelling test is really more significant and far-reaching than the race itself.

New Casting Process

One of the most interesting events to be announced to the public in recent times is a new casting process which has been developed using a plastic mold. The process was discovered in Germany where it was known as the Croning process. It came to this country among the alien patent rights which could be taken over by American industry and has now been put into active operation by a company in Boston.

A resin binder developed by the Bakelite Division is used for mixing with a trivial amount of sand to make the cores and molds. The pattern from which the mold is to be formed is made of metal and is first heated in an oven to bring it to between 400F and 600F. The pattern is removed from the furnace and the Bakelite-resin mixture is applied to the hot pattern. The resin melts and the mixture in contact with the pattern solidifies, forming a continuous coating. Any excess resin-sand which is not melted readily drops off the pattern when it is turned to one side. The pattern is again put in a heating furnace for a few minutes to completely melt the loose residual resin mixture. When the pattern is removed from the furnace and allowed to cool, it is easy to knock off the tan-colored plastic mold which has a high degree of rigidity and structural strength and resembles a shaped cookie about ¼ inch thick and extremely smooth where it has been in contact with the metal pattern. The mold is stable, has good strength characteristics and can be stored indefinitely without changing in shape or form. In addition, it is highly porous and can vent gases directly through its surface.

For the casting process, the mold is placed in a suitable box backed up with steel shot or other appropriate material to hold it in place, and the casting poured in a conventional manner. The resultant casting is noteworthy for its high quality precision, clean sharp surfaces and close dimensions. It is also so smooth that no sand blasting is required. In fact, many castings can be made in essentially finished form by this method. For extremely high precision only finish machining is required as there is no danger from sand damaging the finishing tools.

It seems highly probable that bearing backs and other precision parts for the lubrication industry can, in the future, be made by this process.

Torch

Mr. Louis A. Falligant has invented a torch. This normally would not be considered to have much news value, but his torch is unique and brings a new idea into the field of portable equipment.

In order to develop his new idea, it was necessary for the Phillips Petroleum Company, to blend a new fuel boiling at a temperature of 39 F. This fuel is supplied in disposable containers, arranged so that the torch mechanism can be clamped on to the top of the disposable container. Operating at normal or inside air temperatures (above 39 F) the fuel vaporizes and feeds a controlled amount of vapor to the torch head. A portable, handy unit with no necessity of refilling fuel nor carrying heavy tanks thus becomes available and should have widespread application. Each can contains enough fuel to operate the torch from one to four hours, depending upon the size of flame.

B. H. JENNINGS

COMPRESSOR LUBRICATION*

by K. L. Hollister
Technical and Research Division
The Texas Company, New York, N. Y.

Mr. Hollister, after graduating as a Mechanical Engineer from the University of Michigan in 1926, was employed by Ingersoll-Rand in the Diesel Engine and Air Compressor Departments as test engineer and in other capacities.

In 1932 he joined the Technical and Research Division of The Texas Company, New York, N. Y., where he specialized for many years on the lubrication of heavy machinery. He became Assistant to Manager of the Division in 1947.

Mr. Hollister is a member of the ASLE and ASME.

Right after the war, a comprehensive study of compressor lubrication was made, particularly from the standpoint of evaluating the newer type oils as compressor lubricants. In making this study, first, the properties of the various oils were determined in the laboratory†; second, the requirements of different type compressors were examined, and, third, the best oil for each type compressor was selected. Since that time, for the past several years, results of this investigation have been applied commercially with considerable success.

As a basis for the evaluation of the newer type lubricants, five commercial oils were chosen, all having a viscosity of approximately 300 seconds at 100 F. These five oils were:

1. A straight naphthene oil.
2. The same naphthene oil inhibited against rust and oxidation.
3. The same naphthene oil compounded with 3% fatty oil.
4. A detergent heavy duty oil.
5. A straight paraffin base oil.

Identifying tests on these oils are shown in Table 1.

Table 1

IDENTIFICATION TESTS

Oils	Gravity	Saponification Number	Ash, %
Inhibited Naphthene	23.1	.03	.00
Straight Naphthene	23.1	.03	.00
Compounded Naphthene	23.3	6.50	.01
Detergent Paraffin	27.5	1.60	.24
Straight Paraffin	29.3	.03	.00

Having selected the five oils, they were next subjected to a gamut of physical and chemical tests designed to measure characteristics of interest from the standpoint of compressor lubrication. The first consideration was, of course, the most important function of a lubricant, namely to reduce friction and prevent wear. The factors which are of interest in this connection are viscosity, evaporation, film strength, and water reaction.

It will be noted from Table 2 that as would be expected, since all oils have the same viscosity at 100 F. the naphthene oils are less viscous at 210 F. Calculations show, however, using the $\frac{ZN}{P}$ formula applied to a conventional compressor that the difference in viscosity at 210 F. between the oils is not sufficient to appreciably affect the coefficient of friction or the film thickness.

The rate of evaporation of the various oils at 250 F. is also shown in Table 2 and while there is a difference between the oils, even in the case of the most volatile oil, in an average compressor the evaporation is less than 5% of the total oil consumed. In other words, over 95% of the oil is removed from the cylinder walls by mechanical action and any difference in the evaporation characteristics of the oils is of no concern at the comparatively low cylinder wall temperature.

The film strength values as measured on the Almen machine are also given in Table 2. The compounded oil will give slightly more protection against scuffing while the detergent oil is considerably better in this respect. In a compressor, however, most wear is due to contamination against which the EP agents offer no protection and, therefore, only in rare cases will a high film strength oil be needed.

Table 2

WEAR FACTORS

Oils	Viscosity at 210 F.	Evaporation Oz./Sq. Ft. Per Hr. @ 250 F.	Almen EP Valur Lb./Sq. In
Inhibited Naphthene	48	.020	4,000
Straight Naphthene	48	.016	4,000
Compounded Naphthene	48	.020	5,000
Detergent Paraffin	54	.006	10,000
Straight Paraffin	54	.003	4,000

Water affects the lubrication of an air compressor in two ways. If it condenses on the cylinder walls, it will interfere with lubrication and cause wear. If it is present in any portion of the system, rusting may occur. Rusting in a compressed air system cannot be tolerated since the rust particles may reach the rubbing surfaces of either the compressor or the pneumatically operated machines. It will be noted from Table 3 that the five oils were subjected to the ASTM Rusting Test, Humidity Cabinet Tests and their water separation or emulsifying tendency compared. It was found that the rust and oxidation inhibited oil and the detergent oil offer the best protection. It can be concluded, therefore, that if good water separation is desired, as is the usual case, the inhibited oil would be preferred. If, on the other hand, water is actually condensing on the cylinder walls, then an emulsifiable lubricant is needed and either the detergent or the compounded oil should be used.

To determine where condensation occurs in a compressed air system, the relative humidity has been cal-

* Paper presented before the New York Section of A.S.L.E.

† Texas Company Laboratories, Beacon, N. Y.

culated at various points. From Table 4, it will be noted that even though air having a relative humidity of 100% is admitted at the air intake of the compressor, the only place that the air becomes saturated in the entire compressed air system is in the after-cooler and in the distribution lines. Thus, an emulsifiable oil is seldom needed in compressor operation, except where:

1. The compressor cylinder jacket cooling water is considerably below atmospheric temperature.

2. Inter-cooling is insufficient and super saturated air reaches the higher stage cylinders.

Table 3

WATER REACTION

Oils	ASTM Rusting Rating	Humidity Cabinet Rating	Water Separation Quality
Inhibited Naphthene	1	2	Non-emulsifying
Detergent Paraffin	2	1	Emulsifiable
Compounded Naphthene	3	3	Emulsifiable
Straight Paraffin	4	5	Non-emulsifying
Straight Naphthene	5	4	Non-emulsifying

Table 4

CONDITION OF AIR PASSING THROUGH 100 Lb. SINGLE STAGE COMPRESSOR

	Gauge Pressure lbs./sq. in.	Temperature F.	Relative Humidity %
Atmosphere	0	65	100
Beginning of Compression	0	75	74
15-lb. Compression	15	172	12
End of Compression	100	485	>1
Aftercooler at 138 F	100	138	100
Leaving Aftercooler	100	80	100+
End of Transmission Pipe	97	65	100+
Tool Exhaust	0	35	43

The biggest problem met in compressor lubrication is the operator, who, on experiencing wear increases the amount of oil fed to the compressor resulting in excessive carbonization at the discharge valves. Wear in a compressor is usually due to contamination of the air and seldom to insufficient lubrication. Therefore, an excess of oil should seldom be fed to the compressor even as a temporary expedient.

However, even in the best regulated compressors, carbon may deposit on discharge valves. Therefore conditions, under which this carbon forms, deserve consideration. Table 5 shows the temperatures at the discharge valve at various pressure and it will be noted that the temperature may vary from 200 F. to 500 F. At the discharge valves the lubricant therefore lies on a flat, often horizontal surface exposed to high temperatures for a considerable length of time. This results in the formation of carbon, the amount and nature depending on the type of oil, the compression temperature and the design of the valve.

Table 5

AIR COMPRESSOR DISCHARGE TEMPERATURE

Compression Pressure lbs./sq. in. gauge	Approx. Compression Temperature F. Single Stage	Two Stage
50	350	210
100	500	250
200	—	310
300	—	350

In order to select a laboratory test which would correlate with the tendency of the different oils to form carbon on discharge valves, the oils were lined up as in Table 6, based on their service performance. It will be noted that neither the oxidation resistance nor the carbon residue tests evaluated the oils in order of service rating. Consequently, it was necessary to devise a special test in which the oil was exposed on a flat plate in a thin film for 24 hours at various temperatures and the residue determined. It will be noted that this test, as would be expected, checked very well with service experience. It also will be noted that the carbon forming tendency also varied with the rate of evaporation, the oils which evaporate quickly leave the least carbon.

Table 6

CARBON FORMATION INDICATORS

	Thin Film Residue % @ 350 F.	Evaporation oz./sq. ft./hr. @ 350 F.	Flash Point F.	Carbon Residue %	Oxidation Resistance Rating
Inhibited Naphthene	5	.026	385	.02	1
Straight Naphthene	9	.031	380	.01	4
Compounded Naphthene	10	.031	395	.03	5
Detergent Paraffin	16	.010	435	.37	2
Straight Paraffin	22	.006	440	.01	3

It will also be noted, as would be expected, that the flash point correlated with the rate of evaporation and the carbon formation. This is of interest in connection with air receiver fires and on checking several authorities it was found there was general agreement that to prevent such occurrences, an oil having the least tendency to form carbon should be used, and that flash point should not be given consideration since it is a well established fact that flash point has no relation to autogenous ignition temperature. Incidentally, the ASTM autogenous ignition temperature of the five oils was in each case close to 700 F. Table 7 gives the thin film residue test on two of the oils from which it will be noted that, regardless of temperature, the naphthene oil leaves the least residue. Of interest is the fact that at the lower temperatures the deposit was wet and soft and at the higher temperatures dry and hard.

Table 7

THIN FILM RESIDUE TEST
TYPICAL RESULTS

Temperature F.	Thin Film Residue % Straight Naphthene Oil	Straight Paraffin Oil
250	14	37
350	9	22
450	6	13

The low temperature characteristics are of importance, for example, in portable air compressors and refrigeration machines. In the latter, the pour point which determines the temperature at which wax may form is an important consideration. In portable air compressors, the temperature at which the oil reaches a certain viscosity such as 30,000 seconds is the major consideration, and it will be noted from Table 8 that the oils with the higher viscosity index have the lower satisfactory starting temperature.

Table 8

LOW TEMPERATURE CHARACTERISTICS

Oils	Temperature For 30,000 SSU Visc. Temp. F.	Viscosity Index	Pour Point
Inhibited Naphthene	+10	36	—20
Straight Naphthene	+10	36	—20
Compounded Naphthene	+ 7	46	—20
Detergent Paraffin	+ 4	90	— 5
Straight Paraffin	+ 0	100	— 5

Putting the above information to practical use, let us first consider the conventional single or two stage air compressor. Under normal operating conditions, any good grade power plant or general industrial oil will satisfactorily lubricate the air compressor. Under special conditions, some of which will be enumerated, the lubricant must be more carefully selected. Should car-

bon deposits form on the discharge valve, then either a naphthenic or a detergent oil should be selected. Normally, the naphthenic oils are superior, however, there are designs where the detergent oils have proven most satisfactory. Apparently, it is a case of the rate of flow of the oil across the discharge valve. If the oil lies stagnant, a straight naphthenic oil is more apt to be best. If the oil flows across the valve surface, then the detergent action of the heavy duty oils can be used to advantage. If rust protection is needed then the rust and oxidation inhibited oils should be used. If condensation of water on the cylinder walls is causing wear, then either the detergent or the compounded oil is preferred. In the rare case where scuffing occurs, the high film strength of the detergent oils can be used to advantage. Where low temperatures are encountered, the higher VI paraffin oils should be selected. If oil-free air is needed as in the case of food processing or diving operations, then a straight mineral non-volatile paraffin base oil of fairly high viscosity is needed.

For high pressure air compressors heavier oils are usually recommended, not only because of the increased compression pressure, but often because of the necessity of keeping the stuffing box well sealed. Since the heavier naphthenic oils are rather difficult to manage at atmospheric temperatures, where heavy oils are required paraffin base lubricants are generally used. Such oils are also preferred because of their greater resistance to oxidation, which is more prone to occur in high pressure machines where there is a higher concentration of oxygen. Should valve deposits occur, however, the naphthenic oils should be used. In this connection, as indicated in Table 9, it is interesting to note the extent that viscosity increases under pressure.

Table 9

EFFECT OF PRESSURE ON VISCOSITY OF A TYPICAL HEAVY COMPRESSOR OIL*

Gauge Pressure lbs./sq. in.	*Viscosity* SUS @ 210 F.
0	100
5,000	170
10,000	240
15,000	310

*Based on Table 3, page 822, *Mech. Eng.*, December, 1945

Where gases other than air are compressed, straight mineral oils should normally be used, at least with such gases as carbon dioxide, nitrous-oxide, hydrogen, freon and ammonia. Straight mineral oils are also used with hydrogen sulfide and sulfur dioxide. However, where such gases containing sulfur are used, extreme care must be taken to keep the oil dry and avoid entrance of water into the system. Compressors handling oxygen and chlorine should be built so that no lubrication is required.

Where petroleum gases are compressed there are several factors that must be taken into consideration, such as the absorption of gas by the lubricant. Therefore, normally when compressing petroleum gases the oil viscosity should be about one grade heavier than when compressing air. If the gas contains liquid petroleum, such as entrained gasoline, to resist the washing effect compounded oils are often used. Where unstable refinery gases are compressed, the detergent oils have been found most effective in preventing gum and lacquer deposits. Where petroleum gases are compressed to high pressures, steam cylinder oils are recommended.

Air compressors are used in connection with Diesel engine applications. For the starting air compressor previous comments apply. For the injection air compressor, which is usually an integral part of air injection Diesel engines, compounded oils are often used. Here the problem is the prolongation of the life of the intercooler made of copper tubes through which the air passes at high velocity. Rapid erosion of these tubes occurs due to the combination of the high velocity and any foreign particles in the air stream. Compounded oils seems to resist this erosion while the detergent oils, on the other hand, have a scoring effect and tend to shorten the life of the inter-cooler tubes. The third application of air compressors in Diesel engine operation is in the superchargers or the scavenger blowers which furnish air directly to the engine. These blowers operate at high speed and require a light oil for bearing lubrication. Often the same oil used in the Diesel is applied to the supercharger or blower bearings. However, in most cases, a lighter oil fed from an independent lubrication system is preferred.

Compressors are, of course, the most essential element in refrigeration systems. With rare exceptions, the naphthenic oils having low pour points and good water separating characteristics are offered.

Rotary positive displacement compressors, such as the vane type, require heavier oils to seal the rubbing surfaces and prevent wear. The hot plate effect is absent in these machines, and consequently, paraffin base oils, often containing rust and oxidation inhibitors, are recommended.

For centrifugal blowers the only lubricant required is for the bearings which are usually grease lubricated. Only highest quality anti-friction bearing lubricants are recommended as this has proven to be rather severe service.

The bearings are the principal elements requiring lubrication on the axial flow compressor and a light viscosity rust and oxidation inhibited oil is preferred.

A vacuum pump is essentially a compressor operating at an intake pressure below atmospheric and a discharge pressure near atmospheric. The paraffin base oils are generally recommended for vacuum pumps for, being least volatile, their consumption will be lowest. There is also an absence of any heat condition which would require the naphthenic type oils. For high vacuum pumps the oil should be most carefully selected, a narrow cut paraffin stock being required. In many applications a considerable amount of water enters at the vacuum pump intake and at the same time the amount of oil leaving the vacuum pump at the discharge valve is considerable. This mixture of oil and water is usually removed from the air by a separator, which is an integral part of the vacuum pump. From this separator, the water is drained off and the oil is returned to the compressor lubrication system. It is, therefore, highly important that the oil have good water separating characteristics. Where the vacuum pump is handling air or other gases containing foreign matter, as in the case of pigment industries, detergent oils have proven satisfactory in preventing deposit formation.

Considerable care should be used in selecting a lubricant for a compressor. However, the problems involved are well recognized and their solutions well known. If the lubrication recommendations of a qualified lubrication engineer are followed, satisfactory performance will be assured.

SEE PAGE 171
FOR
1951 ASLE CONVENTION
HI-LITES

STUDIES OF THE LOAD-CARRYING CAPACITY OF SLEEVE BEARINGS*

by C. M. Allen and K. A. Davis
Battelle Memorial Institute
Columbus, Ohio

Mr. Allen received his B.E. degree in mechanical engineering and metallurgy from the University of Toledo in 1941. His particular field of specialization and interest has been in research and development engineering. After serving in the capacity of metallurgist for sveral well-known corporations, he joined the Battelle Memorial Institute as Research Engineer.

Mr. Davis received his B.S. degree in electrical engineering in 1947 and his M.S. degree in physics in 1948, from the Ohio University. He was a research associate at Harvard University, after which he joined the General Electric Company as an engineer. Mr. Davis is now a Research Engineer at the Battelle Memorial Institute.

Summary

During the course of a fundamental study of sleeve bearings, bearing tests were run on materials like copper, brass, constantan, and Invar, as well as on conventional bearing materials. Surprisingly good results were obtained on the unconventional bearing materials, and this was ascribed to the high degree of perfection existing in the test. Therefore, tests were run with various imperfections known to exist in service, such as dirty lubricant, rough surfaces, and misalignment. Under these conditions, copper still performed better than either babbitt or copper-lead.

If it is assumed that copper is not a good material in actual bearing service, this result implies that some factor which affects bearing performance is not present in the test. Studies are continuing to determine what this factor may be.

Introduction

During the course of a fundamental study of bearing behavior, it has been observed that good sleeve bearing performance was obtained from poor bearing materials. This result is not anticipated in actual bearing service. In order to appraise the difference between practical service conditions and the laboratory tests, a brief description of the testing machine, test bearings, and testing procedure will be necessary.

Test Bearings

The test bearings, having a nominal diameter of 1.25 inches and a length of one inch are mounted in a very rigid housing. A press fit and a set screw hold the bushing in place. After rough boring, the bearings are finished in a special precision boring jig.[1] The jig is a device which may be attached to a standard lathe so that a cylindrical surface, accurate to 0.00002 inch, may easily be obtained. In this work a diamond tool is used to prevent taper resulting from tool wear. A typical value of longitudinal surface roughness is ten microinches rms.

The shafts are made of hardened steel (42 Rockwell C) ground on a conventional cylindrical grinder. The test area is accurate to 0.00002 inch.

The Testing Machine

A sleeve bearing testing machine capable of applying a load continuously variable from 0 to 12,700 psi of projected bearing area is used in this work. Figure 1 shows this machine with one main bearing removed to show the test bearing. The test shaft, which is supported at each end by a ball bearing, is driven by a countershaft through a flexible coupling. The countershaft is driven by a 5 hp electric motor and shaft speeds from 300 to 10,500 rpm can be obtained.

The test bearing is loaded unidirectionally and is pressure lubricated, SAE No. 10 oil at 200 F. and 40 psi gage pressure through an axial oil groove on the unloaded side of the bearing. The lubricant is kept clean by passing it through filters but, for specific tests, grit may be injected into the oil line.

The diametral clearance for all the tests was 0.002 inch.

Testing Procedure

It is well known that the load-carrying capacity of sleeve bearings depends somewhat upon the method of testing. In the present work, the bearings were tested with and without wearing in. The load-carrying capacity is also a function of the rate of load application. In these tests, the load was increased from 0 to 10,000 psi in increments of 500 psi. The time required for increasing the load by 500 psi was about 20 seconds. After the application of the additional load, the bearing was run about three minutes at the increased value. During this interval, the average bearing temperature

* Paper presented at 5th Annual Convention of A.S.L.E., Detroit, April 11, 1950.

[1] Dayton, R. W., Allen, C. M., "Lathe Fixture Bores to Exceptional Tolerances," *American Machinist*, Vol. 21, February 10, 1949.

increased a few degrees and then remained constant. The fact that the bearing temperature attains a constant value is interpreted to indicate satisfactory performance of the bearing at that load.

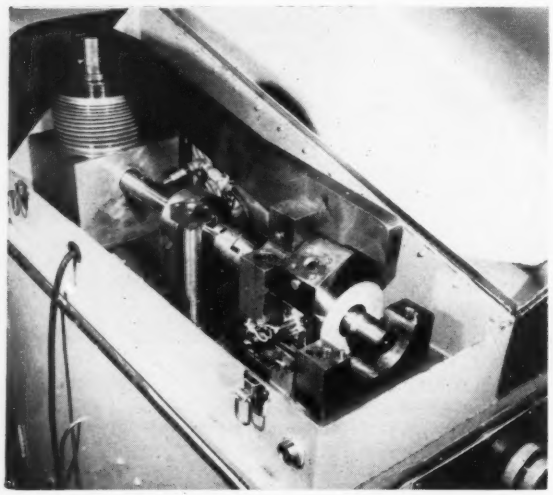


Fig. 1

Photograph of the sleeve bearing machine used in testing the load-carrying capacity of sleeve bearings. The test bearing rests on the shaft between the two main ball bearings. One main bearing has been removed so that this photograph may show the test bearing housing. The load is applied to the bearing housing by an air bellows which operates through a lever. The load is transmitted from the lever to the bearing housing through a steel ball seated in a curved steel cap which fits over a small portion of the bearing housing periphery. Oil, under high pressure, is forced between the cap and the housing so that the housing is free to adjust its position. Rotation of the housing is prevented by an attached cantilever which rests on a fixed support. The bending of this cantilever is a measure of the bearing friction. Self-alignment of the test bearing is insured by loading through the steel ball.

A bearing which successfully completes the sequence described with a filtered lubricant may be given a grit injection test. The procedure is like the first, except that, after the bearing temperature attains a constant value, 10 cubic centimeters of oil containing 15 milligrams of 14-micron silicon particles is injected into the lubricant line leading to the test bearing. The grit is only circulated once, as it is picked up by the filters after it passes through the test bearing.

Discussion of Tests and Results

During the course of an investigation of the nature of bearing seizure, some tests were run on highly unconventional materials which, it was thought, would perform very poorly. The results were totally unexpected. For example, a constantan bearing (66% cu, 40% Ni) worn in for 10 hours at a shaft speed of 1,500 rpm, supported a load of 9,000 psi. An Invar bearing (63.8 Fe, 36% Ni, .2% C) worn in for 10 hours supported a load of 6,000 psi. More extensive tests were made on brass bearings (66% cu, 34% Zn.). After being worn in for 15 hours, these operated satisfactorily at loads as high as 12,700 psi without failure. Brass bearings, which were not worn in for so long a period, supported a load of 9,000 psi. Galling did not occur during failure and, upon releasing the load immediately after failure, restarting the machine and loading again, the bearing sustained a load of 6,500 psi before failing a second time. This bearing was failed in this manner twenty times. During the first ten failures, its load-carrying capacity was only slightly affected, but by the time it was failed twenty times the load-carrying capacity was reduced to 4,000 psi.

These results were quite unexpected. Bearing experts would consider all of these materials poor for use as bearings, yet the loads which they supported were quite high. The results remind one of a statement which appears frequently in bearing literature, that, in an ideally operating bearing, the materials are of no significance whatever.

It was reasoned that, in the bearing test, conditions approached ideal ones so closely that very "poor" materials could support very high loads. It was thought further, that such results could not be obtained in service because of imperfections in the operating conditions.

Owing to these considerations, it was decided that tests should be made to determine what departure from ideality were especially destructive to bearings. For this work, a series of tests was run on a very dependable material (babbitt, 5% Sb, 5% Cu, 0.35 Pb, balance Sn), a heavy duty material (copper-lead, 72% Cu, 25% Pb, 3% Sn), and a material which would be expected to be very poor in service (copper, 99.6%). Imperfections which were expected to be representative of service were introduced into the tests.

The imperfections tested were shaft toughness, edge loading (misalignment), and grit in the lubricant. All bearings were tested by incremental loading up to 10,000 psi, first lubricated with filtered oil, then, upon this evidence of satisfactory performance, they were tested with oil containing 14-micron grit particles. Those bearings which failed with filtered oil were not tested with grit injection. The results of these tests are presented in Figure 2.

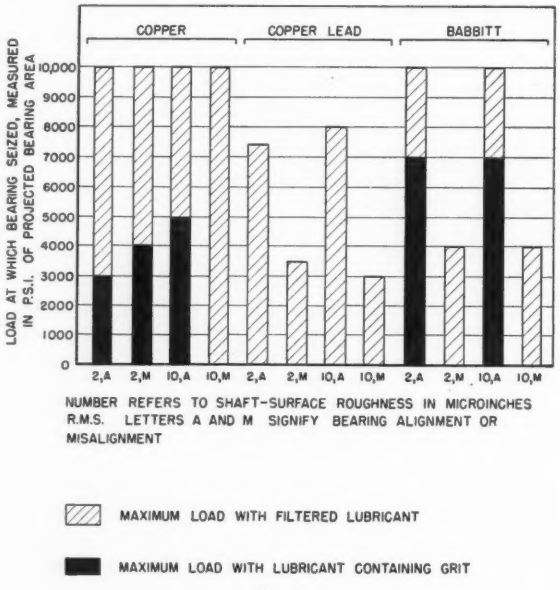


Fig. 2

The load-carrying capacity of sleeve bearings.

Copper had the best over-all performance. Furthermore, copper is not susceptible to edge loading, whereas babbit and copper-lead are. The superior performance of babbit in the presence of grit is evident.

(*Continued on page* 182)

FUNDAMENTALS OF CUTTING FLUID ACTION*

by M. Eugene Merchant
Senior Research Physicist
The Cincinnati Milling Machine Co.
Cincinnati 9, Ohio

Dr. Merchant received his B.S. degree in Mechanical Engineering at the University of Vermont. His graduate work was done at the University of Cincinnati in the Graduate Department of Applied Science under a cooperative fellowship sponsored by the Cincinnati Milling Machine Co. Here he majored in Physics and received the Doctor of Science degree in 1941.

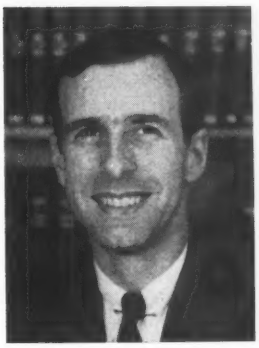
He has since been employed in the Research Department of the Cincinnati Milling Machine Co. and is at present Senior Research Physicist, conducting basic research on metal cutting, cutting fluid, friction and lubrication.

Dr. Merchant has published numerous papers on metal cutting, friction, and lubrication, and is co-author with Hans Ernst of the chapter on "Principles of Metal Cutting and Machinability" in the Tool Engineers Handbook.

Dr. Merchant is a member of various technical societies, including A.S.L.E., A.S.M., A.S.M.E., A.P.S., A.C.S., and O.S.A.

He has served as a National Director of the American Society of Lubrication Engineers, is at present Mid-Western Regional Vice President, and Chairman of the General Technical Committee of that society, as well as Chairman of the Cincinnati Section, and is active on several A.S.T.M. and A.S.M.E. lubrication committees.

Honorary fraternities include Phi Beta Kappa, Tau Beta Pi, and Sigma Xi.



Basic Functions

In practice a cutting fluid is called upon to perform many different functions depending upon the type of machining operation to which it is applied. However, there are two basic functions which any cutting fluid *must* perform well, if it is to be effective in aiding the machining process. These two basic functions are:

1. To remove heat from the cutting tool, workpiece and chips (i. e., to cool).
2. To reduce the friction between the flowing chip and the cutting tool, thus reducing the heat generated in cutting and in addition providing other benefits.

It is these two basic functions which are discussed here, with particular emphasis on the second, since it is the least commonly understood of the two.

The major benefit to be obtained from a cutting fluid which effectively performs the above two functions is that of improved tool life (with consequent lower machining costs). Tool life, with a given tool-work combination, is mainly a function of the temperature of the cutting tool. In fact the relationship between tool life and the temperature of the cutting tool has been found empirically by Schallbroch, Schaumann and Wallichs[1], and is quite simple. It is an equation of the form

$$Tt^n = K \qquad (1)$$

where

T = tool life, min.
t = temperature at chip-tool interface, C°
n = an exponent the value of which depends mainly on the tool form and material
K = a constant the value of which depends mainly on the tool material and work material

According to the above authors, the exponent "n" in Eq. 1 normally has a value of roughly *twenty*, in the case of high speed steel tools. While it is not known whether such a value for the exponent will always be found in practice, it does appear that the value is always large. Thus it is evident that a very small change in tool temperature will produce a large change in tool life. For example, in a particular case Eq. 1 was found to be of the form

$$Tt^{24} = (740)^{24}$$

Then if

$$t = 625C$$

$$T = \left(\frac{740}{625}\right)^{24} = 57 \text{ minutes}$$

but if

$$t = 600C$$

$$T = \left(\frac{740}{600}\right)^{24} = 150 \text{ minutes}$$

In other words, in this case a fall of 25 degrees in tool temperature raises the tool life from about 1 hour to 2½ hours; i. e., a 150% increase in tool life.

The importance of controlling tool temperature in machining is evident from the above. An effective cutting fluid provides such control when it performs the two basic functions mentioned above. The direct cooling action of the cutting fluid lowers tool temperature; so does the friction-reducing action, which lowers the amount of heat generated in cutting, as will be shown. In addition, however, the friction-reducing action of a cutting fluid also provides other benefits—it improves chip formation, provides better surface finish, reduces the machining forces and lowers the power required to remove a given amount of metal—as will be seen.

Cooling

The importance of the direct cooling action of a cutting fluid in increasing tool life and so saving money for the users is evident from what has been said above. A variety of factors control the effectiveness of the direct

* Based on a paper originally presented at the 3rd annual convention of A.S.L.E., Buffalo, N. Y., April, 1948. Revised for publication.

[1] H. Schallbroch, H. Schaumann and R. Wallichs, "Testing for Machinability by Measuring Cutting Temperature and Tool Wear," Vortrage der Hauptversammlung 1938 der Deutschen Gesellschaft fur Metallkunde, V.D.I. Verlag, pp. 34-38, 1938.

cooling action of a cutting fluid; most of these are already well known to the reader. Thus high specific heat and high heat conductivity, together with a low film coefficient for heat transfer, are necessary for good cooling. A low fluid temperature and the greatest possible area of contact between the cutting fluid and the hot tool, chip and workpiece are also important. For instance, because of the part played by the above properties, pure water is about twice as effective in carrying away heat, volume for volume, as is the average mineral oil. and is in fact one of the most effective cooling agents known. However, pure water is, of course, unsuited as a cutting fluid because of its corrosiveness and its lack of good friction-reducing properties. If mineral oil is emulsified in water (which provides some corrosion control but not necessarily any friction-reducing ability, as will be seen) the cooling ability of the water is impaired. Thus one of the main considerations in providing effective cutting fluids is to combine high cooling ability, such as that provided by water, with effective friction-reducing ability, without impairing either function.

Friction Reduction

The second basic function of an effective cutting fluid—its ability to reduce the friction between chip and tool—has been mentioned several times above. How important is this function? What part does it play in machining? How can it be obtained in a cutting fluid? In order to answer questions such as these it is necessary to know some facts about the mechanics of the metal cutting process. Recent research[2] in this field has revealed certain basic facts that have a direct bearing on the action of a cutting fluid. In the process of chip formation, heat is evolved from two sources:

1. The energy used up in deforming the metal.
2. The energy used up in overcoming friction between the chip and tool.

All of the power delivered to a cutting tool is converted into heat in one or the other of these two processes—roughly two-thirds of the power goes into deforming the metal and one-third into overcoming chip friction. It is this heat which destroys the cutting tool in the manner already discussed. Anything which can be done to lower the energy used up in deforming the metal or in overcoming chip friction will reduce the amount of heat generated and thus lower the temperature of the cutting tool and prolong its life.

The basic processes of chip formation are shown schematically in Fig. 1. The processes of deformation of the metal ahead of the tool to form the chip and of escape of that chip by sliding up the tool face can be recognized. The deformation of the metal takes place by a process of shear or plastic flow occurring in a zone which is essentially a plane extending from the cutting edge to the surface of the work. This plane is shown in Fig. 1 making an angle Φ with the direction of tool travel. It is known as the shear plane. The layer of metal of thickness t_1 is deformed (by undergoing shear as the plane advances with the tool) into a chip of thickness t_2. This chip then slides up the face of the tool meeting with frictional resistance as it slides. The application of an effective cutting fluid under normal conditions will reduce this frictional resistance between chip and tool. This will reduce the heat evolved from the energy used up in overcoming friction, just as in a normal process of boundary lubrication. However, in the case of metal cutting, this is not the only effect of this friction reduction. In metal cutting it so happens that a lowering of the coefficient of friction between chip and tool also brings about reduced deformation of the metal being removed, Thus, less energy will be used up in that process also, reducing the heat evolved from that source, too.

The way in which this comes about is that a reduction in the friction between chip and tool causes an increase in the shear angle of Fig. 1. This means that the plane of shear becomes shorter and a thinner chip is produced from the same size of cut, i. e., dimension t_2 becomes smaller while dimenssion t_1 remains unchanged.

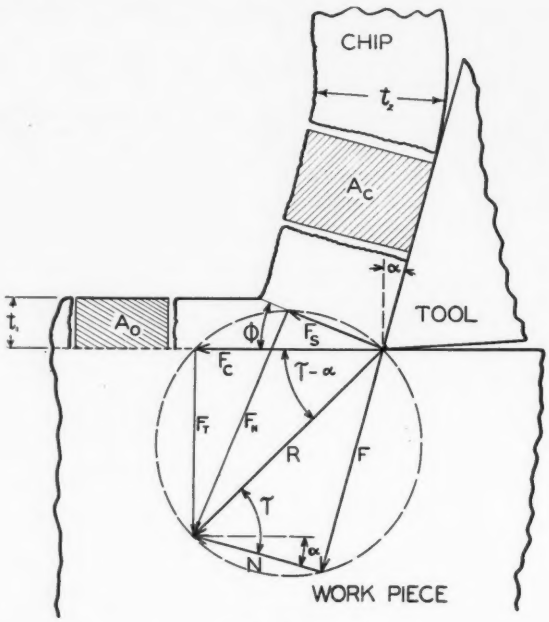


Fig. 1

Chip formation in metal cutting involves deformation of the metal and sliding of chip on tool, and is accomplished by a definite system of forces.

The Cutting Ratio

The fact that the deformation of the metal in machining becomes less as friction between tool and chip is lowered is not only known from the theory of the mechanics of cutting, but can be easily observed from experiment. The ratio of dimension t_1 of Fig. 1 to dimension t_2 is a convenient measure of the deformation of the metal in cutting and is known as the "cutting ratio." The larger the value of the cutting ratio (which theoretically must lie between zero and one) the less the deformation, as may be seen from Fig. 1. If several cutting fluids differing in their ability to reduce friction are applied to the cutting operation and measurements of both the cutting ratio and the friction between chip and tool are made, the cutting ratio will be found to increase with decreasing chip friction, indicating less deformation of the metal as friction is lowered. Experimental data of this type, obtained from cutting tests made with a large number of different chemical compounds used as cutting fluids, is shown in Fig. 2. It is evident that the deformation of the metal is considerably less at low values of chip friction than at high values.

[2] M. Eugene Merchant, "Mechanics of the Metal Cutting Process," Parts I and II, *Journal of Applied Physics*, Vol. 16, pp. 267-275, 318-324, 1945.

Postage Will be Paid by Addressee

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD

First Class Permit No. 5161 (Sec. 34.9, P.L.&R.) Cincinnati, O.

LUBRICATION ENGINEERING

American Soc. of Lubrication Engineers, Publisher

22 East 12th Street

CINCINNATI 10, OHIO

_____, _____
(Date & Month) (Year)

Gentlemen:

☐ Please enter my subscription for LUBRICATION ENGINEERING for .....years, effective with the.....issue, published bi-monthly.

☐ Please send me information regarding membership.*

Regular Subscription $4.00 per year ☐
$7.00 for Two Years ☐
Payment Mailed ☐ Send Bill ☐

Name..... Title.....

Company .....

Street Address.....

City..... Zone..... State.....

With which branch of the Lubricating Industry is your company identified:

Manufacturing ☐ Consulting ☐ Educational ☐
Lubricant Producer ☐ Servicing ☐ Other ☐

*Note: Membership Includes Subscription to LUBRICATION ENGINEERING.

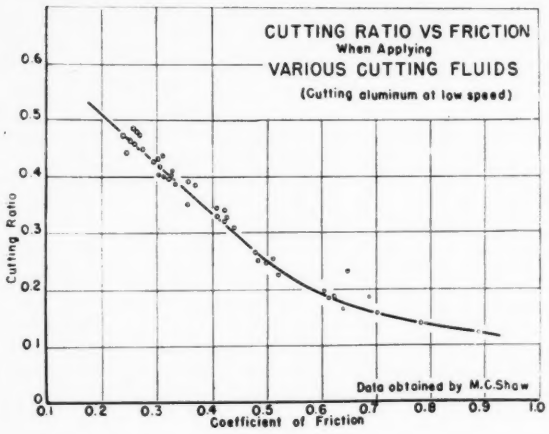


Fig. 2

Cutting ratio, as a measure of deformation, is directly related to chip friction; thus it can be used to measure chip friction.

As seen from data such as that in Fig. 2 the cutting ratio, as a direct measure of deformation, is a function of the friction between chip and tool. This fact means that the cutting ratio can also be used as an indirect measure of chip friction, other things being constant (i. e., with a given work material, tool material, tool geometry and size of cut). Since the cutting ratio is much more simply measured than is chip friction, this makes the cutting ratio a convenient quantity to use for checking the relative friction reducing abilities of various cutting fluids.

Another important conclusion from data such as that shown in Fig. 2 is that cutting fluids very definitely *do* have the ability to reduce friction between chip and tool—some of them very considerably. Each different experimental point plotted in Fig. 2 represents a different cutting fluid. Some are very effective in reducing chip friction; some are poor. The reason for such differences will be made apparent.

Benefits of Friction Reduction

As explained above, lowering the friction between chip and tool by use of a good cutting fluid not only reduces the heat produced by friction, but also lowers the heat produced from deformation of the metal. As an example of this, take the case of a typical machining operation on steel, with and without a cutting fluid. Assume that the use of cutting fluid reduces the friction between chip and tool by only 10%. Then the resulting decrease in the heat produced by friction and by deformation of the steel are as shown in Table I. It will

TABLE I

TYPICAL EFFECT OF REDUCED CHIP FRICTION ON HEAT PRODUCED IN MACHINING

Alloy steel: Shear strength = 100,000 psi
Machining constant = 75°

Tool: True rake angle = 15°

Condition	Coefficient of Friction	Heat Evolved From Chip Friction, Btu/Lb. of Metal Removed	Heat Evolved From Deformation of Metal, Btu/Lb. of Metal Removed
Dry	1.0	43.9	95.6
Cutting Fluid	0.9	40.3	90.3
Percent Decrease	10%	8.2%	5.5%

be noted that the lowered chip friction due to the use of a cutting fluid not only lowers the heat evolved from friction by 8.2% but also lowers the heat evolved from deformation of the metal by 5.5%. The total heat generated when the cutting fluid is used is less by 8.9 Btu per lb., which (assuming for simplicity that the heat is uniformly distributed throughout the metal being removed) would mean that the average temperature of the chip would be lower by 45 C. (81 F.) This, of course, is apart from any direct cooling action of the cutting fluid, which would still further lower the cutting temperatures.

When a cutting fluid performs its basic function of friction reduction, therefore, it produces the double result of reducing the heat evolved from friction and also that evolved from deforming the metal. This double-barreled "lubrication" effect is unique to the metal cutting process. However, as already indicated, this is not the only benefit coming from lowering the friction by use of a cutting fluid in the machining process. For one thing, the power needed to remove a given amount of metal is reduced. In the example given in Table I, for instance, if metal were being removed at the rate of 15 cu. in. per min., then the 8.9 Btu per lb. saved when the cutting fluid was applied would mean that the power required for machining would be reduced by almost one horsepower. Further, the force acting between tool and work would be lowered. Using the same example, that of Table I, if the rate of metal removal were 15 cu. in. per min. and the cutting speed 100 ft. per min., then the total force on the tool (force R of Fig. 1) would be about 5300 pounds when cutting dry, but would be reduced to about 4800 pounds when the cutting fluid was applied.

In addition, better chip formation and a smoother finish are obtained when friction between chip and tool is lowered by use of a cutting fluid. Ernst[3] has shown that a rough, torn surface in machining is caused by the presence of a built-up edge on the nose of the cutting tool. This comes about due to high chip friction. Application of a cutting fluid that lowers chip friction reduces the size of the built-up edge or may even eliminate it entirely. Thus, the lower the chip friction, the better the surface finish. This is illustrated in Fig. 3.

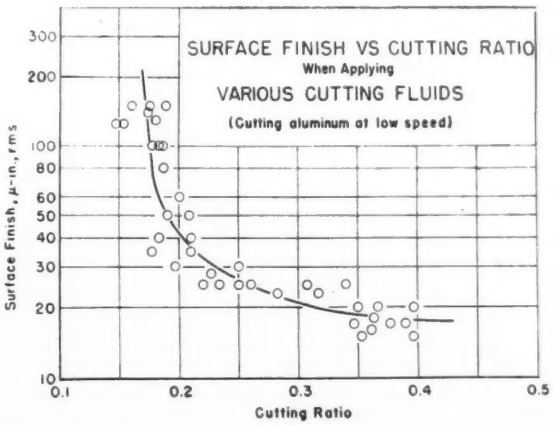


Fig. 3

Reducing chip friction improves surface finish by reducing the size of the built-up edge.

Here cutting ratio is used as a measure of chip friction as described above—high cutting ratio means low chip friction and vice versa. It may be seen from Fig. 3 that surface finish improves very rapidly at first, as chip friction is reduced by use of successively better cut-

[3] Hans Ernst, "Physics of Metal Cutting," Machining of Metals, American Society for Metals, Cleveland, Ohio, 1938, pp. 1-34.

ting fluids. This is due to the rapid reduction in size of the large built-up edge present at the initial high value of friction. As the friction is further reduced, however, the curve tends to flatten out due to the vanishing of the built-up edge. In the present case it appears that above a value of cutting ratio of about 0.35 the built-up edge is absent and no further improvement in surface finish is possible with further friction reduction.

Mechanism of Friction Reduction

It is evident from the above that cutting fluids can and do reduce chip friction in metal cutting, with very real benefit. How, though, do they accomplish this? Pure hydrodynamic action (fluid film lubrication) is out of the question since temperatures and pressures at the chip-tool interface are very high and the geometry does not favor the formation of a wedge film. Bisshopp, Lype and Raynor[4] have given a good example of this fact.

Fig. 4 shows schematically how a highly magnified view of a tiny section of the chip-tool interface might look. Minute capillaries exist at this interface due to the fact that the surface of a cutting tool (or any surface, for that matter) can never be perfectly smooth, at least on a submicroscopic scale. These capillaries draw in the cutting fluid (or its vapors, which can often be equally as effective!) just as a sponge soaks up water. However, pressures at the tiny points of actual contact between chip and tool have been found to run as high as several hundred thousand pounds per square inch and local flash temperatures at these points may run to several hundred degrees! Thus fluids, unchanged, are powerless to prevent metal-to-metal contact at the high points; they will be squeezed out. Research into the nature of the friction between clean metal surfaces has shown that wherever metal touches metal a continuous "bridge" between chip and tool will be formed, equivalent to a weld. Under these conditions, sliding can only occur by shearing these "metal bridges"; the shear strength of the chip metal itself must be overcome.

If a fluid, as such, cannot stop metal from "bonding" to metal at the tiny contact points, how then can the cutting fluid present in the capillary spaces do anything to lower friction or resistance to sliding? Recent research[5, 6] has shown that it does so by chemical action. Note that the surface of the chip which bears on the tool is one freshly formed from the bulk metal; as such it is highly reactive. This condition, combined with the severe strain in the metal and the above-mentioned high pressures and temperatures at the contact points, makes an ideal combination for promoting chemical reactions. It has been discovered that, if the cutting fluid (or its vapors!) contains materials which are at all reactive with the chip metal, a chemical reaction takes place at the chip-tool interface.[7] This has been proven by direct chemical analysis of the resulting products. If the products of this reaction are of the right type, they can effect friction reduction. The necessary condition is that the reaction products (which will coat the contact areas with a surface film as the reaction proceeds at these points) must be *solid* (i.e. non-fluid) materials having *low resistance* to shear. Non-fluid materials cannot be squeezed completely from between two solid surfaces, no matter what the loads or pressures on those surfaces. Thus when such films are present, the chip and tool are separated by a microscopic "sandwich-filling" of weak non-fluid material which will prevent metal-to-metal contact and reduce the resistance to sliding. Only the shear strength of this solid film has to be overcome as sliding occurs, rather than the shear strength of the previously described "metal bridges."

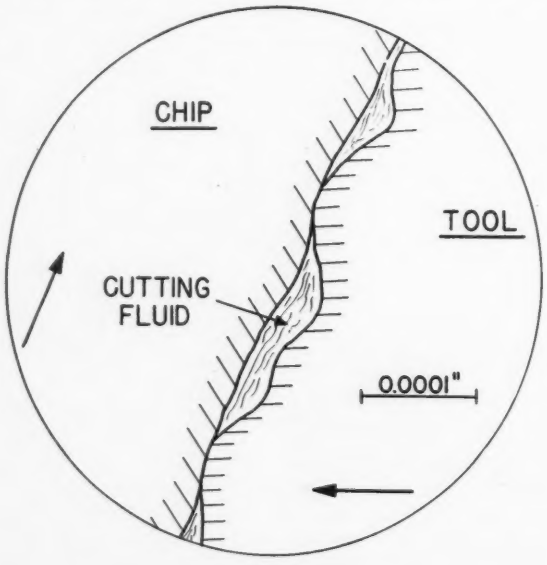


Fig. 4

Minute capillaries between chip and tool draw in the cutting fluid; then chemical reaction with the chip metal produces a solid film that prevents metal-to-metal contact.

The fact that this is the mechanism of friction reduction by a cutting fluid is borne out by experiment. As an example, the data in Table II is presented. This was obtained from cutting tests on four different pure metals (iron, copper, aluminum, lead) with two different pure cutting fluids (carbon tetrachloride and a special alkyl sulfide). The observed reduction in friction when the given cutting fluid was applied to each given metal is tabulated. This is compared with the calculated reduction in shear strength at the chip-tool interface which should occur according to the above mechanism. This reduction in shear strength would be that brought about by the change from the resistance to shear offered by the metallic "bridges" (shear strength of the chip metal) to that offered by the main products of the chemical reaction (shear strength of the solid film). These calculated shear strength values are *relative* values calculated from the equation.

$$S = 0.142\ L\rho\ \log_e T_m/T \qquad (2)$$

where S = static shear strength of crystalline solid, kg/mm^2

T = temperature of the solid, degrees absolute

T_m = melting point of the solid, degrees absolute

L = latent heat of fusion of solid, cal/gm

ρ = density of solid, gm/cm^3

[4] K. E. Bisshopp, E. F. Lype and S. Raynor, "The Role of Cutting Fluid as a Lubricant," LUBRICATION ENGINEERING, Vol. 6, No. 2, pp. 70-74, 1950.

[5] Hans Ernst and M. Eugene Merchant, "Chip Formation, Friction and High Quality Machined Surfaces," Surface Treatment of Metals, *American Society for Metals*, Cleveland, Ohio, 1941, pp. 299-337.

[6] Milton C. Shaw, "The Chemico-Physical Role of the Cutting Fluid," *Metal Progress*, Vol. 42, pp. 85-88, July, 1942.

[7] Milton C. Shaw, "Mechanical Activation—A Newly Developed Chemical Process," *Journal of Applied Mechanics*, Vol. 15, pp. 37-44, March, 1948.

TABLE II

OBSERVED REDUCTION IN FRICTION BETWEEN CHIP AND CUTTING TOOL BY APPLYING CUTTING FLUID, COMPARED WITH CALCULATED MAXIMUM REDUCTION PREDICTED FROM SHEAR STRENGTH OF SOLID FILM

Metal Cut	Calc. S For Metal (S_m) kg/mm²	Cutting Fluid	Probable Main Constituents of Solid Film Produced By Cutting Fluid	Calc. S For Film (S_f) kg/mm²	Calc. Max. Reduction in Friction Between Chip and Tool $(1-S_f/S_m)100$	Observed Reduction in Friction
Iron	133	Carbon Tetrachloride	$FeCl_2$	38	71%	80%
			Fe_2Cl_6	15.5	88%	
		Alkyl Sulfide	Fe S	62	53%	60%
			$Fe S_2$	—*	——	
Copper	98	Carbon Tetrachloride	Cu_2Cl_2	10.4	89%	65%
		Alkyl Sulfide	Cu_2S	4.2	57%	55%
Aluminum	41	Carbon Tetrachloride	Al_2Cl_6	9.2	78%	65%
Lead	7	Carbon Tetrachloride	$Pb Cl_2$	19	—170% (An Increase)	—50% (An Increase)

*Heat of Fusion Unknown

Chip Thickness (t_1) 0.002 in.
H.S.S. Tool, + 15° True Rake
Cutting Speed 5.5 in./min.

The use and derivation of Eq. 2 have been described elsewhere[5, 8]. It may be seen that the values of the observed reduction in friction in Table II approach closely, in most cases, the calculated values for the maximum possible reduction to be expected according to the above mechanism. In particular, the case of carbon tetrachloride applied to the cutting of lead is quite significant. The shear strength of the expected reaction product, lead chloride, is *greater* than that of lead so that an *increase* in friction between chip and tool should result when the cutting fluid is applied, according to theory. Such an increase was actually observed as may be seen from the data in Table II.

The cutting tests, from which the data in Table II was obtained were carried out under conditions "ideal" to the obtaining of maximum friction reduction from a given cutting fluid. A very low cutting speed (5.5 in./min.) was used and pure, active compounds were the cutting fluids. This was done for the purpose of studying and demonstrating the mechanism of friction reduction. Because of this, conditions were right, during the process of chip removal, for the pure compound to penetrate thoroughly the chip-tool interface and react fully with the chip metal there, coating it completely and thus providing the maximum fricton reduction possible with that compound. In actual machining practice, conditions are seldom ideal and so reductions in friction as great as those given in Table II are seldom found, as explained in the next section. Nevertheless the friction reduction which does take place with cutting fluids in practice (which may often be considerable) still is brought about by the same chemical mechanism as explained above. It is the chemical additives to cutting fluids which make them effective in reducing chip friction. For instance, sulfurized and chlorinated additives form the corresponding solid sulfides and chlorides of the metals at the chip-tool interface, such materials as free fatty acids form the corresponding metallic soaps, etc. The oil or water which carry these additives play little if any part in friction reduction; they are merely carriers for the chemically active materials. Thus the chemical properties of a cutting fluid play the major role in helping it perform its important basic function of friction reduction. Control of the chemical reactions occurring at the chip-tool interface holds the key to major advances in cutting fluid performance.

Cooling Versus Friction Reduction

As already indicated, the amount of friction reduction obtained with a given cutting fluid depends very much on the conditions under which it is used. For example, cutting speed has a pronounced effect. This is illustrated in Fig. 5, where cutting ratio (as a measure of chip friction) is plotted as a function of cutting speed, for several quite different cutting fluids. It may

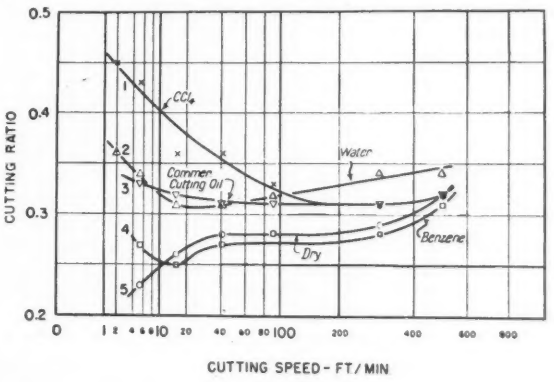


Fig.5

Friction-reducing abilities of cutting fluids drop off with increasing speed, but cooling ability becomes increasingly important.

be seen that as cutting speed is increased, the cutting fluids tend to become less effective in reducing friction; they all approach the condition obtained when no fluid is used (dry cutting).* Thus cutting fluids may be quite effective in reducing chip friction at low and medium speeds (and some may even increase in effectiveness with increasing speed, over a certain range of speeds). At some upper limit of speed, usually about 200-300 feet per minute, however, friction reducing ability normally tapers off toward zero. This behavior is due mainly to the fact that at these speeds and above, the time of contact of any given element of chip surface with the tool face is too short to permit penetration

(*Continued on page* 181)

[8] Hans Ernst and M. Eugene Merchant, "Surface Friction of Clean Metals," Proceedings of Massachusetts Institute of Technology Summer Conference on Friction and Surface Finish, June, 1940, pp. 76-101.

"THE LUBRICATION ENGINEER"— HIS ESTABLISHMENT AND DEVELOPMENT IN INDUSTRY

by G. D. Jordan
B. Eng., G. I. Mech. E., A. F. Inst. Pet.

Mr. Jordan graduated from Sheffield University with a B.E. degree in 1944. After serving with the British Navy as Engineer Officer, he joined Samuel Fox & Co., Ltd., the Sheffield steel founders, and is now Lubrication Engineer of that company.

We are reprinting this article from the *Journal of Incorporated Plant Engineers*, Birmingham, England, (Vol. 1, No. 13, July-August, 1949) because it indicates the awareness of the importance of the "lubrication engineer" in English industry. We feel that the British viewpoint of this significant subject will be of interest to our readers.

Introduction

The establishment of the Lubrication Engineer in British industrial life is an innovation of some importance. Moreover, it is a position which will be more generally accepted in an ever widening field of application in line with the advance of industry. Consequently, this paper aims at the introduction of the subject in such a manner that the development, purpose and prospects of the Lubrication Engineer may be more readily understood.

It is, however, desirable in these introductory remarks, to make clear that the contents of this paper express primarily the opinions of the author, based on a comparatively short period of specialized experience in the field of industrial lubrication. Within the limits of this proviso factual information generally has been presented. Therefore, it is submitted with some reserve that, being opinions, they are open to discussion, and, if we agree that discussion is a healthy form of criticism possibly resulting in beneficial findings, it is the author's sincere hope that such will prove to be the case.

Foreword

Previously the Plant Engineer has exercised a rather tolerant attitude towards the question of lubrication without delving into the potential advantages to be gained. Whilst fully aware of glaring cases of complete mechanical failure directly attributable to this disregard for closer study of the subject, he is otherwise eager to play his part in ensuring continuity of plant operation. Generally speaking, these troubles arise from the fact that Plant Engineers, operating under the stress of a common policy urging one to "keep the plant running at all costs," find themselves fully occupied on plant repairs. It may be considered that this outline of the apparent failings of the Plant Engineer is overstressed, but who can doubt that pressure from those in authority, where other weighty problems have been encountered, has inevitably resulted in a general measure of inability to tackle, with all resources, the multiplicity of problems concerning the mode of application, working condition, deterioration, etc., of lubricants?

The advent of mass production methods in the U.S.A. together with rapid advances in processing steel imposed more arduous plant operating conditions and resulted in greatly increased frequency of mechanical failures entailing coincidental financial losses.

The importance of the correct application of lubricants was consequently brought to the fore, resulting in the appointment of engineers specifically trained with a view to eliminating these troubles through the medium of efficient lubrication. These men were appointed (perhaps tentatively at first, but more rapidly as their value became evident) until today in most, if not all, large plants the Lubrication Engineer stands supreme in his own sphere.

A further stage of development in the U.S.A. has terminated in the appointment, in the larger plants, of a Chief Lubrication Engineer. Through the medium of his staff, whose individual responsibilities are focussed on a single or group of departments, he is able to maintain a tight control on lubrication and the use of lubricants throughout his plant. Furthermore, he is responsible to the Chief Engineer for the design and installation of lubricating systems on new machinery, and also to the Maintenance Engineer for the maintenance which these systems will entail.

Such a revolutionary policy, carried out with typical thoroughness, has reaped gratifying dividends by cutting down breakdown delays and consumption of power, lubricant and bearing material.

Progress in similar directions in this country has been comparatively slow. We have not, however, been lacking in knowledge. Early pioneer work by such men as Reynolds, Towers, and so on, has done much to formulate and clarify the fundamental laws of lubrication, and anyone who has read the papers presented for general discussion before the Institution of Mechanical Engineers in 1937 cannot doubt the enormous interest and progressive thinking which that Institution has stimulated.

Yet, with all this, there was something lacking so far as industry was concerned. It is surely true to say that all the wealth of experimental and theoretical knowledge, in whatever sphere of thinking, must be put in practical use before its full value can possibly be realized. No doubt, the recent war, with its aftermath of critical shortages of coal and imported crude oils, has culminated in bringing into the limelight the need for specialist engineers whose sole responsibility is that of tending to the wants of lubrication in industry. Whatever the reason it is now apparent, through the appointment of such men, that an active interest, which I trust will wax rather than wane, has commenced.

Qualifications

Let us move on to consider the background of knowledge desirable in the Lubrication Engineer. He should have first and foremost a sound practical training coupled with a firm grounding in basic theory of Mechanical Engineering. Some inkling of Electrical Engineering is a great asset, the value of which will become more real as problems, concerning transformer and switch gear oil, are met. As may be said for most professions, a deep rooted enthusiasm and a firm conviction of the possibilities of his subject should predominate. A natural bent for instilling enthusiasm into personnel, whose outlook on the subject is somewhat indifferent, is a gift found in few men and not easily acquired by others. Nevertheless, every endeavor should be made by the Lubrication Engineer not so gifted to pass on to his fellows some of his own knowledge and zeal.

A further requirement or qualification, which differentiates the Lubrication Engineer is the ability to absorb some (but not necessarily a great deal of) knowledge of chemistry. The chemical nature of crude oil and its derivatives is of the utmost value. In his orbit of operation the Lubrication Engineer must co-operate with the work's chemical laboratory over the testing of lubricants and should also be able to converse on equal terms with the lubricant manufacturers.

Unfortunately very few educational facilities are available in this country for the engineer desiring to take a specialized interest in the subject of lubrication. One of the major oil companies realizing this deficiency, has made available to the steel and ancillary industries an excellent course covering the latest technique in the manufacture of lubricants. They appreciate that if the engineer and the manufacturer can discuss together problems on lubrication in the same language then both parties will reap the rewards of common interest, and incidentally improve the running efficiency of industry.

The lubricating equipment manufacturers are also eager to associate themselves with any moves industry might make in the world of lubrication. They, too, have arranged brief courses.

Coupled with these two facilities, mention should be made of the wealth of technical literature available, particularly that published by the Institute of Petroleum and the American Society of Lubrication Engineers. Through whatever medium knowledge is gained there is no more fertile source of knowledge than practical expereince of everyday problems.

Purpose and Aims

The purpose of the lubrication engineer is to maintain "Efficient Lubrication." These two words contain a wealth of meaning which may be detailed under the heading "Aims." These indicate the chief purposes and are as follows:—

(a) *Knowledge of plant and co-existent lubricants*

The first aim of the newly appointed Lubrication Engineer should be to acquaint himself with the lubricating systems, and co-existent lubricants appertaining to the particular plant under his control. This should be done with thoroughness while the opportunity is available, and permanent records built up. The form these records take, is dependent upon the individual, but a card index system provides immediate and complete reference. These should preferably be 8″ x 5″ in size, one side being utilized to list under a departmental heading the following:

(i) the machine,
(ii) the machine plant number,
(iii) the system of lubrication,
(iv) the quantity and frequency of application of the lubricant,
(v) the grade of lubricant,
(vi) the works reference number of the grade of lubricant.

The back of the card is left blank, and may be used for sketching the lubricating system on the plant referred to.

(b) *Education and Propaganda*

One of the most difficult tasks facing the Lubrication Engineer is that of educating those responsible for the direct lubrication of plant into the correct method of so doing. The personnel responsible may be—

(i) the machine operator who tends to his own particular machine,
(ii) a departmental or sectional "greaser" who tends to the needs of a number of machines or pieces of plant, or
(iii) a combination of (i) and (ii).

The big danger with (i) is that individual operators have a tendency to neglect lubrication, particularly if they be on piece work. Stoppages of any kind mean less in the pay packet, yet they fail to realize that through the maxim "a little applied often" the danger of stoppage is minimized. The same danger arises in (iii) though to a lesser extent. System (ii) is to my mind the most ideal. The departmental or sectional "greaser" is not swayed by financial gain, he has an overall picture of the plant in his charge, he has access to the stores, and has sufficient time to perform his tasks thoroughly and efficiently.

In passing it should be pointed out that the status of the "greaser" has been related to that of a laborer. This should not be the case. The responsibility and far reaching effects of negligence on his part call for a man of intelligence and practical ability. Not until his status is raised shall we have the right type of man for this wrongly called "odious task."

Having referred to the man who applies the lubricant let us allude to ways of educating him. The infusion of a lubrication-conscious attitude into men with set routines is a difficult barrier to overcome. Nevertheless, a great deal of useful work can be done in this direction by the following four methods:—

(i) by personal example. This calls for a constant vigil on the plant and personal contact with personnel. Advice, hints and guidance on the subject all form part of a verbal attack directed at forming an impression on the mind of the workpeople. This is a long term policy which should be part of the everyday routine of the Lubrication Engineer, but with patience

and perseverance it can have far-reaching effects.

(ii) by talks to works Production Committees. This has a limited application, yet through the medium of the members of these Committees, who are generally shop-leaders and sometimes outspoken individuals, propaganda can be spread throughout the works.

(iii) through the medium of the works magazine. An article on Lubrication, providing technicalities are avoided, can reach a larger audience than any other means.

(iv) by the method of propaganda posters. These should be placed at prominent positions throughout the works and must be so designed as to create an immediate and lasting impression on the mind. Pictorial representations of a single idea are far more effective than a list of do's and dont's. The average mind is more capable of assimilating one idea at a time, especially if this is portrayed by a picture which bears a surprising relationship to the idea. The picture is the pile that drives home the purpose behind the rule of conduct expressed in a sentence.

The art of poster propaganda is difficult to acquire but the publicity section of any works can be of great assistance in this direction.

(c) *Bulk storage of lubricants*

The advantages to be gained by bulk storage of lubricants are numerous. The factor of cleanliness and favorable financial considerations are in themselves sufficient to warrant a serious study of this aspect. Before so doing, however due consideration should be given to the oils and greases to be so handled.

Over a period of years the number of different grades of lubricants has reached alarming proportions, occasioned by duplication under similar sets of plant working conditions. This has been due to lack of co-ordination between departments and to makers' recommendations on new machinery being followed too litterally. The Lubrication Engineer can provide the bond between departments and can also advise on the lubricants to be used on new machinery from those in existence on the plant, without resorting to makers' specifications and thereby introducing a new or duplicate grade.

However, before so doing, present conditions must be righted. By co-operation with the oil companies a survey of plant may be carried out, whereby grades of lubricants are listed against individual machinery according to the set of conditions operating thereto. The survey complete, unnecessary qualities may be weeded out by the method of "compromised lubrication" until a few oils and a few greases will sufficiently and efficiently satisfy the needs of the whole plant.

Having established these conditions, investigation into the design and operation of a suitable bulk storage plant can be followed up bearing in mind, of course, the consumptions of the individual grades.

(d) *The testing of lubricants*

The Lubrication Engineer should be familiar with all the normal tests carried out on oils and greases. It is not feasible to expect him, however, to take charge of any system of testing. This should be a service provided by the Works Laboratory and is advisably better so.

The Lubrication Engineer should stipulate the particular tests he requires, and also furnish the Laboratory with test report sheets, so that results may be filed for future reference.

The most important application of testing is on used oils. By frequent testing at fixed intervals the results obtained may be charted and failure due to deterioration thereby avoided. It should be remembered that it is the rate of change of acidity, viscosity, water content, etc., that is of more importance than a "spot" analysis.

Testing may also be applied for random checks of new oils and greases in order to ensure that fresh deliveries are up to the manufacturers' specification.

(e) *Prevention of Wastage*

In these days of shortages and dollar difficulties (being considerations from a national point of view) and taking into account the annual expenditure of lubricants from a works internal point of view, the Lubrication Engineer can do much to make his presence felt by incurring a reduction in consumption of lubricants on the plant under his care. Wastage may be due to a number of factors such as overenthusiasm or negligence in applying lubricants, broken or damaged seals, worn bearings, lack of facilities for completely emptying oil and grease drums, use of improper grades, method of application, i. e., hand or mechanical, and so on. All these undesirable factors may be improved or entirely obviated by a careful study of each problem, and by the introduction of improved methods. Consumption charts should be built up so that any benefits may be observed.

(f) *Reclamation of used oils*

Closely allied with the problems of wastage is the reclamation of used oils. So far as is possible, such oils should be recovered for service either in their original capacity or for some slightly inferior duty. Settling or centrifuging followed by filtration through the edge-type filter will extend the life of oils many times. By closely watching test results the oils may be revivified continually before permanent deterioration sets in.

In smaller systems byepass filtration with occasional batch filtration is usually sufficient, but on larger circulating systems continuous filtration of the type just described is advisable.

Greases are not amendable to reclamation but even these may be employed, after initial use, for very rough jobs such as the greasing of mill floors.

(g) *Lubricating systems*

The modern trend in lubrication has been influenced by the automatic or semi-automatic methods of application of grease or oil. These have attempted to remove the human element and ensure that a metered quantity of lubricant reaches the moving parts. Great strides have been made in ensuring efficient lubrication with a constant supply yet minimum expenditure of lubricant.

It is the obligation of the Lubrication Engineer to examine existing methods of applying lubricants and to recommend mechanical systems where expedient. He should be responsible for the design and installation of equipment and should draw up maintenance schedules thereto.

(*Continued on page* 180)

1951
CONVENTION HI-LITES

Plan now to attend the 1951 ASLE National Convention — to be held at the Bellevue-Stratford Hotel in Philadelphia,

April 16, 17, & 18

The contemplated program will be one of the best ever presented!

ARE YOU A LUBRICATION ENGINEER?

You will be interested in the many "how to lubricate" papers.

IS YOUR INTEREST IN RESEARCH OR TECHNICAL SUBJECTS?

If so you will enjoy the unusual and interesting papers along this line.

HAVE YOU QUESTIONS CONCERNING LUBRICATION?

There will be ample time and qualified persons on hand to help you.

Here are some of the **"HI-LITES"** of the 1951 program.

ECONOMICS OF LUBRICATION

Such subjects as — what planned lubrication means to management, effect of proper lubrication on occurrence of fires, and storage and handling of lubricants will be discussed. Each of these subjects is of vital interest to persons in management, lubrication engineers and all individuals responsible for proper lubrication of equipment.

TEXTILE

Outstanding authorities from mills and machinery manufacturers will be present to give their views on the proper lubrication of textile machinery.

OIL DETERIORATION

Factors contributing to oil oxidation and methods of minimizing oxidation both from the designer's and user's point of view will be presented in a most interesting way.

METAL WORKING

An outstanding paper on the theory of grinding and the function of grinding fluids as well as papers on drawing and forming compounds will be given.

SURFACE PROTECTION OF MACHINERY

Papers to be read during this session will be applicable to every type of machinery. Protection of both external and internal surfaces of machinery against rusting will be covered from a theoretical as well as a very practical point of view. Wire rope lubrication and protection will be included also in this session.

INTERNAL COMBUSTION ENGINES

Here is an opportunity to ask those questions you have wanted to know the answers to for a long time. A panel will be present, made up of outstanding authorities in the marine, railroad and stationary Diesel, high speed Diesel and gasoline bus and truck fields. Interest already developed in this session indicates it will be one of the outstanding features of the convention.

* * *

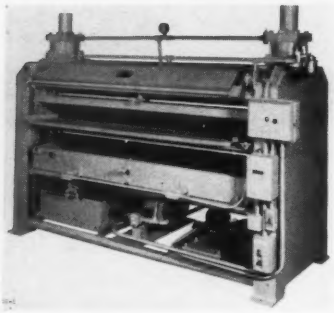
This is a partial listing of the many interesting subjects to be covered. Watch for this column in the next issue of LUBRICATION ENGINEERING *in which will be given additional "HI-LITES" of the 1951 ASLE National Convention.*

FLASH!

A.S.L.E. National Program Committee under the able Co-Chairmanship of Mr. J. C. Van Gundy, The Texas Company and Mr. M. A. Dewey, E. I. Du Pont de Nemours & Co., Inc., submit for your attention their plans for the coming Convention. Ensuing issues will keep you informed of further developments.

DON'T MISS THIS FEATURE

NEW PRODUCTS and EQUIPMENT



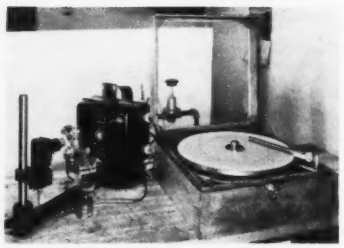
Machine Application: Bertsch Machinery Co., 9397 Hubbell Ave., Detroit 28, Mich. — The above company has many successful installations of their new special roll coating machine for the applications of drawing compound on coils, strip stock or almost any standard press production. The manufacturer states that the drawing compound may be applied in any desired quantity through the use of a controlled spreading roll. The machine is said to successfully handle all types of compounds, including lard and wool fat in mineral oil, graphited compounds and water solubles. Further information may be obtained by addressing the manufacturer, Dept. R.

Gear Spray Gun: Binks Manufacturing Co., 3114 Carroll Ave., Chicago 12, Ill.—Available now for open or semi-enclosed gears. This gun is so designed that one or more guns may be permanently located at each set of gears. Lubricant is supplied by standard grease pumps. Guns may be operated at proper intervals of time, either by hand operated valves, hand operated switches or electric time switches. It is claimed this new development eliminates to a great extent the human factor, effects a remarkable saving in lubricant, and does away with the dangerous and uncertain hand method of gear lubrication. For full information, write the above company, requesting Bulletin No. 635.

Alemite Primer: Stewart-Warner Corp., 1826 Diversy Pkwy., Chicago 14, Ill.—"Eleven Ways to Cut Production Costs" are graphically portrayed in a pocket size booklet on industrial lubrication, published by the Alemite Division of the above company. Examples of production or machinery expense economies, attained through modern handling and application of greases and oils, are presented. Advantages over methods they are designed to improve are given in terms of lubricant savings, increased production, use of machinery and elimination of labor costs or machine repair costs. Available on request by writing the above.

"Dag" Bulletin: Acheson Colloids Corp., Port Huron, Mich.—No. 426 is one of the series of bulletins on the application of "Dag" colloidal graphite in numerous industries. Various applications are cited. Also, instructions for its use as a lubricant in cutting and on high speed precision tools. Copies available by writing the above company.

Handy Andy Model: Balcrank, Inc., Cincinnati 9, Ohio.—Formation of a separate division of Balcrank, Inc., to specialize exclusively in industrial and farm lubrication equipment, is announced by Mr. C. M. Doiseau, President of the Cincinnati company. The new division, to be known as the Handy Andy Line, will shortly introduce two recently designed booster pumps and two gun fillers. The unit HA-2, shown with new 6-oz. Balcrank hand gun attached, fits all 25-50 lb. original containers. A new catalog and price list on Handy Andy is in preparation and will be distributed in June.



Lubricator Test: C. A. Norgren Co., 222 Santa Fe Drive, Denver 9, Colo. —The testing equipment pictured above is used to count the number of drops per minute fed into the oil stream of the fog lubricator, and a graphic recording is made to show the exact time at which each drop reached the air line. This test is important for insuring constant oil feed.

Hydraulic Fluid: Monsanto Chemical Co., St. Louis 4, Mo.—Development of a flame-resistant industrial hydraulic fluid, said to have high lubricity, is announced. The fluid is an ester base compound, containing no halogenated hydrocarbons, salts or water. It is claimed it will not corrode bearings or other metal parts, and is a non-conductor of electricity.

Lubriko Greases: Master Lubricants Co., Meadow & Jackson Sts., Philadelphia, Pa. — Designed as a lubricant for anti-friction bearings, Lubriko is available in a range of 14 different densities, each designed for a specific purpose. The manufacturer claims their full line takes into consideration practically every lubrication problem encountered in the use of ball or roller bearings.

E. Chicago Plant: American Cyanamid Co., 30 Rockefeller Plaza, New York, N. Y. — Announcement is made of the construction of a $3,000,000 plant that will produce cracking catalysts for the important segments of the petroleum industry, located in the Midwest and along the Atlantic seaboard. Construction was started only after an intensive study was made for the requirements of this region. The new facilities are expected to be in operation the middle of 1951. Cyanamid is one of the leading producers of catalysts.

NEWS OF THE SECTIONS

Reading from left to right: Messrs. Dougherty, Hollingsworth, Moorehouse, Hall.

KINGSPORT

Submitted by Mr. E. L. Forbes, member of the above Section.

"The first technical meeting of the newly organized Kingsport, Tenn. Section was held Friday, June 30th, in the Tennessee Eastman Corp. recreation building.

"Speakers of the evening were:

Mr. D. F. Hollingsworth
E. I. Du Pont de Nemours & Co., Inc.
and President of A.S.L.E.
Mr. R. W. Hall
Technologist of the Texas Co.
Houston, Texas.

Introductory address:

Mr. W. S. Moorehouse
Chairman of the Kingsport Section

"Mr. Hollingsworth presented a brief history of the formation of the A.S.L.E., which received its charter in 1944 and now has 22 active Sections. The aims and purposes of the Society were broadly discussed, stressing the efforts of the organization in the promotion of the advancement of knowledge, research and development, higher standards and improved machine design, and the importance of lubrication in industry.

"Mr. Hollingsworth pointed out that all of the articles appearing in the Society Journal are written by outstanding authorities in the lubrication field.

"Stress was laid on the importance of strong local Sections and their activities in the contribution to the growth of A.S.L.E. as well as in the dissemination of 'know-how' to industry.

"Mr. Hall's topic was 'Research —Pattern for Progress', accompanied by a film developed by The Texas Co. The modern research and development methods and facilities for bringing to the public better products in the lubrication field was shown. This included the various phases of production from well drilling to the finished product. The modern techniques and methods for improving and producing better petroleum products were illustrated. The significance of the performance of these products was shown in the test fleet of engines operating under every conceivable condition. A brief discussion on additive oils brought out the importance of protection in our modern machinery of extremely high speeds and heavy loads. The research for new products for new needs came in for considerable comment, including the building of pilot plants and their operation for the production of synthetic oils. Mr. Hall told of the modern methods of exploration and production. The fact that the utilization of petroleum products has become a science, as in production, received merited discussion.

"A period of questions and answers followed Mr. Hall's talk.

"Dean Dougherty of the University of Tennessee feels that to a great extent, the lubrication field is in its infancy. His comments on the opening of new industrial frontiers, through the extensive research programs in the petroleum field, reveal that while we have gone far, we may expect even greater progress and further new products.

"Refreshments were served upon adjournment."

Your editor would like to comment on the progressive spirit shown by the officers and members of the Kingsport Section. The *Kingsport Times* carried a ⅔ page advertisement with the pictures of Messrs. Hollingsworth and Hall, announcing the meeting. This indicates a healthy future growth for this group. The National organization is proud to number Kingsport among its Sections.

LOS ANGELES

Secretary Ott reports that Mr. Linville's talk was presented in a very practical manner. Illustrations with various homemade props simplified the technical subject matter.

"Oils—Past—Present—Future," by Mr. Wallace Linville, Editorial Director, Petroleum Educational Institute.

"All petroleum products are hydrocarbons, meaning that they are composed of atoms of hydrogen and atoms of carbon. If they arrange themselves in a chain shape, they are called paraffinic molecules and in a ring shape, naphthenic molecules. Vacuum distillation is used to sort varied sizes of molecules into certain boiling ranges. The product of the distillation process is known as neutral oil. The residual material is known as cyl. oil and, if blown with steam for further refinement, it is called steam refined cyl. oil. Further treatment with acid-solvents or filtration produces what is known as bright stock. Acid and solvent treatment are used to remove unsaturates. Acid treatment is a chemical process, while solvent treatment is a physical process. Further refinement and improvement in color is obtained by filtration. The problem in making lubricating oil is not just a matter of refining, but in knowing when to stop.

"The characteristics of the two basic types of crudes were discussed and applied to gear lubrication. Pitting and scoring and scuffing failures were described . . . 'Pitting, within practical viscosity limits, is independent of the lubricant while scoring and scuffing can be con-

trolled with auto-welding type additives' . . .

"Bearing problems, cylinder wear, and ring sticking were also discussed.

"Oil development, as influenced by Caterpillar, Chevrolet, and the General Motors diesel engine, was followed . . . 'The war demanded that the individual problems of these engines be met by *one* oil. This was a *big order* but was accomplished by a free industry—free to think—free to dream—free to do'. Regular, premium, and heavy duty type oils were described and the 2-104b with the new supplement 1 and 2 oils were discussed.

" 'This is an age of additives' . . . said Mr. Linville in closing, . . . 'The past and present have been brilliantly handled, the future is in capable hands.' "

DAYTON

Mr. H. L. Sellers, former Secretary of this Section, reports on the last two meetings.

April — "Electrical Equipment Lubrication" by Mr. E. H. Erck of the Eclipse Pioneer Division, Bendix Corp. "The discussion was begun with the tracing of the progress of aviation up through the Wright Bros. to present aircraft industry. The aircraft industry is made up of three divisions: engine, airframe and accessory. Since Eclipse Pioneer is primarily interested in the accessory group, Mr. Erck, with the use of slides, illustrated the research and development in the gyroscope, both air and electric driven, the starter, generator and electric propellor controls. As the improvements were made, it was necessary to develop special oils and greases to meet exacting requirements."

May—"Extreme Pressure Lubricants of the Leaded Type" by Mr. C. N. Seelbach of Shell Oil Co., Inc. "Mr. Seelbach opened his talk by stating that industrial designers today are producing heavy industrial equipment to operate under increasingly higher loads, often under adverse conditions. Laboratory and service performance tests indicate that a satisfactory leaded type lubricant should have the following characteristics:

1. Oxidation stability (freedom from thickening and sludge formation).
2. Ability to separate from water.
3. Adhesion and water displacement properties.
4. Load carrying capacity.
5. Stability in storage and in service.
6. Non-corrosive.
7. Non-foaming.

"By a summary of field and service tests, it was pointed out that 'leaded type' lubricants having the above properties were superior to Universal gear lubricants, H.V.I. straight mineral oils and steam refined, compounded and cylinder oil, particularly where shock load conditions exist. The only exception is hypoid gearing. In this application, the proper grade of 2-105 B type universal gear lubricant should be used.

"The usual question and answer period following both meetings offered the members, guests and speakers an opportunity to exchange thoughts on the subjects presented."

BALTIMORE

Submitted by Mr. V. A. Ryan, a Director of A.S.L.E.

"The annual meeting and banquet was held on May 20th at the Park Plaza Hotel. Of the 69 members and guests, 35 were women. Eastern Regional Vice President A. F. Brewer, National Secretary W. F. Leonard and Managing Editor of LUBRICATION ENGINEERING, Patricia Leonard, attended as guests. The affair was toastmastered by Mr. Leonard who, in turn, presided over the business session.

"The outstanding feature of the evening was the principal speaker, Mrs. Florence Conrath Wilmer, who is a world-traveled famous lecturer and is presently Chairman of the Dept. of History at the University of Baltimore. Since a mixed audience was present, she selected a topic of immediate interest to the group and, in the light of increasing sharpness of division between East and West with respect to world affairs, spoke on 'World Government and What You Can Do About It.' The entire talk was clearly and beautifully expressed.

"New officers and executive committee members were officially installed in office at this meeting. (See Section Officers' Page.)

"The annual report for the 1949-50 season was presented by the retiring Chairman, Mr. A. E. Cichelli. The highlight of the report was the fact that an increase over the preceding year was shown:

10.3% in membership
30.4% in attendance at meetings
31.7% in financial standing."

(The date of the above meeting coincided with the birthday of your Managing Editor. The felicitations which were tendered in both song and rhetoric were tastefully presented and humbly accepted).

"The Committee on Programs and Meetings has been working diligently and the speakers' program for the coming season is almost completed. The first fall meeting in September will open with a paper entitled 'The Lubrication and Servicing of Automatic Transmissions' by Mr. P. F. Chappell, Manager of the Technical Division, American Oil Co. This paper should prove to be extremely interesting and will include the basic design of the various transmissions in use at the present time."

Watch this Section's report for a complete program, in the October issue.

CHICAGO

A new approach to a Section report, submitted by Mr. R. A. Kraus, Chairman of the Chicago Section and a Director of A.S.L.E.

"Can you tell why and how a viscosity index improver functions in a petroleum oil? Do you know what property of a lubricant determines its degree of additive susceptibility? Well, if you can't answer either of the above questions, then you should have attended the Chicago Section's 'Stump the Experts' program which was the final formal meeting of the season.

"The board of experts were:

S. E. Sparks, Viscosity Oil Co.
W. H. Fowler, Jr., Pure Oil Co.
Frank Gray, Carnegie-Illinois Steel Corp.
E. M. Wojtasik, Sinclair Refining Co.
G. H. Lancaster, C. T. A.

who were quite capable of answering these and many more questions of similar caliber.

"The panel of judges, consisting of:

W. H. Day, Shell Oil Co., Inc.
W. P. Murphy, Lubri-Zol Corp.
R. A. Kraus, Republic Steel Corp.

called the close ones, while Mr. John Thomas of Shell Oil acted as moderator and distributed the cold, hard cash to those successfully stumping the 'experts'.

"The above panel of experts and jurists represents a fine cross section of the leading authorities on lubrication in the Chicagoland area.

"In addition to the regular program, the election of officers for the coming season was held. (See Section Officers' page).

"Another item of interest during the business meeting was the report that the Chicago Section was the victor of the Chicago-Dayton annual membership contest. This was the second such contest between these two Sections and Chicago's current victory has tied the series at one all.

"The annual golf outing and dinner was held at Mt. Prospect golf

course on June 22nd. Numerous prizes and awards for high and low scores were presented. This is always a very successful affair."

The details of the golf outing, reported by the newly elected Secretary-Treasurer R. W. Regan, reached us just as we were going to press.

"Among approximately 25 door and golf prizes were such items as a table model radio, a Cory coffee maker and a $10.00 merchandise certificate.

Low gross (score 78)
John Mace of Standard Oil Co. of Ind.
Tied for 2nd (score 87)
J. W. Hopkinson of Penn-Petroleum Corp., Detroit, Mich.
A. A. Paul of Brooks Oil Co., Chicago, Ill.
Note: Mr. Paul won 2nd on draw.

"Jack Mace also won first prize for low net, and the additional prizes were awarded members and guests present in order of their low net scores, which were computed by the Claywell Handicap System."

PITTSBURGH

The annual outing and golf party of this Section was held at the Butler Country Club on July 17th. Details will be published in a later issue since the event took place just at the time of going to press.

CLEVELAND

In May, Mr. George W. Miller, President of the Battenfeld Grease & Oil Corp. of New York, was featured with a discussion on "ABC of Lubricating Greases." In his talk, Mr. Miller covered in detail the formulation and uses of all types of greases generally used in industry. The new mixed base greases were also discussed with possible applications to machinery parts heretofore considered unfit for grease lubrication. The points covered were of practical interest to all those present.

The annual golf party of the Cleveland and Youngstown Sections was held at the Alliance Country Club in June.

DETROIT

Chairman Kelly announces the above Section will hold its annual stag outing on Sept. 9, 1950 at the Hillcrest Golf & Country Club, Mount Clemens, Mich.

It is predicted that this will surpass even the highly successful previous outings.

CINCINNATI

Dr. Merchant, Chairman of the Section and a Director of A.S.L.E., reports:

"The first regular meeting of the recently formed Cincinnati Section featured Mr. Charles L. Pope, Chief Lubrication Engineer for Eastman Kodak Co., and most recent past-president of A.S.L.E., as the speaker. The meeting was held on May 18 and was attended by a group of about thirty-five men, representing a variety of Cincinnati industries.

"Preceding the talk, a brief business meeting was held, during which a set of Section By-Laws (based on a model set of by-laws prepared by Mr. Victor Ryan for the Baltimore Section) was adopted. Additional officers were then elected to conform to these by-laws. The following were elected:

"Vice-Chairman, Mr. C. E. Gruen of the Shell Co.; Executive Committee members, Mr. Guy Peters of Oilkraft Inc.; Mr. C. T. Weymiller of the Procter and Gamble Co., and Mr. W. D. Whalen of the R. K. LeBlond Machine Tool Co.

"Mr. Pope's very interesting and beneficial talk was entitled 'The Lubrication Engineer in Industry,' and was illustrated with a series of color slides. He opened by discussing the six essentials of good lubrication: — Correct lubricant, proper service life, correct frequency of lubrication, proper quantity of lubricant, prevention of waste, and proper method of application. He then went on to point out that proper lubrication engineering in industry is a joint responsibility between management and the lubrication engineer; he outlined the responsibilities of both.

"Mr. Pope then turned to a discussion of lubrication problems in industry. He gave details on the factors affecting the performance of bearings, emphasizing the problems encountered because of a lack of knowledge of proper bearing grooving practice. He discussed test methods, emphasizing the practical importance of good oxidation and corrosion tests.

"The talk was concluded with a discussion of lubrication failures and their four main causes:—Lack of lubrication, contamination, electrolysis and oxidation. Each of these was vividly illustrated with color photographs of several actual examples.

"Following the talk, a lively discussion period ensued, with Mr. Pope supplying further information which should help to solve many practical problems for those in attendance.

"The next meeting of the Section is scheduled for September."

FORT WAYNE

New officers were installed in May. (See Section Officers' page)

Mr. J. W. Hopkinson, Chairman, National Individual Membership Committee, was the speaker of the evening. He offered valuable suggestions on two always troublesome subjects; i.e., increase in membership and raising of funds for the individual Sections.

Two short movies on the production of oil were shown, after which refreshments were served.

EVANSVILLE

Mr. Charles L. Pope of the Eastman Kodak Company presented his usual very excellent, illustrated talk. He has visited many of our Sections and is always highly informative on the general subject of lubrication and the lubrication engineer.

BOSTON

"Filtering and Purification of Industrial Oils" by Mr. D. J. Jones, District Manager, Honan-Crane Corp., New York City, was the topic of the May meeting. The subject was well received and followed by an interesting discussion.

CONNECTICUT

Mr. D. H. Van Vleck, Sales Engineer of the Cuno Engineering Corp., addressed this Section at their May meeting, held at the Hotel Sheraton in New Britain. The title of his paper was "Factors Governing the Selection of Filters."

Supplemented by projector slides, this presentation covered the basic types of filters on the market today and the special features and uses of each. It also reviewed the various kinds of solids that filter engineers are required to remove from fluids. In the selection of the right filter to do a specific job, Mr. Van Vleck recommended the choice be determined principally by the type of contaminant the filter is expected to remove.

Mr. Van Vleck is well qualified to discuss filter selection. He has been associated with Cuno Engineering for 15 years, and during this period, faced with the task of solving the filtration problems for a broad section of industry.

(*Continued on page* 189)

CURRENT LITERATURE

American Society For Testing Materials, Technical Publication No. 92, 1949

SYMPOSIUM ON LUBRICATION OF HIGH-SPEED TURBINE GEAR EQUIPMENT PRESENTED AT A MEETING OF TECHNICAL COMMITTEE C OF COMMITTEE D-2 ON PETROLEUM PRODUCTS AND LUBRICANTS, AMERICAN SOCIETY FOR TESTING MATERIALS, FEBRUARY 14, 1949, WASHINGTON, D. C.

LUBRICATION OF NAVAL GEARING
Simpson, R. T.—pp. 3-8

The author outlines the development of improvements in design and performance of the naval gearing. The activities of the Navy Gear Industry Committee in controlling factors which determine gear design and performance and in solving enormous number of problems involving lubrication of gears are taken up. A three-phase program of the proposed investigation is indicated. The first phase of this project will be a comprehensive review of the literature already published or otherwise conveniently available. Phase two will be a survey of the programs being conducted at present by the various other government laboratories. Phase three will be a survey of the programs now being conducted individually by the lubrication laboratories of the petroleum industry.

DEVELOPMENTS IN GEAR DESIGN AND THEIR LUBRICATION REQUIREMENTS
Collins, L. J.—pp. 9-13

The present trend in gear design and manufacture is to produce gears which are smaller in size and lighter in weight than they have been in the past. To accomplish this end, gear teeth will have to operate at much higher surface stresses. For example, where a surface stress of 65,000 pounds per square inch has been used, it would be desirable to double or triple this value. In an effort to render the tooth surfaces as smooth as possible refining methods such as lapping, grinding, shaving and burnishing should be resorted to. The requirements a gear lubricant for gears of the future should satisfy are listed: 1) oil should prevent rusting, 2) oil should reduce the breaking-in period and help obtain a finer surface finish, 3) oil should be low in viscosity to reduce losses and yet be able to withstand 200,000 pounds per square inch, and 4) oil should be able to wet the surface of a polished gear tooth even at very low speeds.

PHYSICAL CONCEPTS OF THE ESTABLISHMENT OF THE LUBRICATING OIL WEDGE AND ITS ASSOCIATED LOAD CARRYING CAPACITY FOR THE MATING TOOTH SURFACES OF HIGH-SPEED GEARS
Gatcombe, E. K.—pp. 14-19

This paper presents some of the physical concepts perceived in the establishment of the lubricating oil wedge which separates the mating tooth surfaces of high-speed gears. The work presented is divided into the following three parts: 1. The establishment of the oil wedge and its associated load-carrying capacity for oil wedges of various shapes, with and without normal and tangential surface motions. 2. Factors which influence the load-carrying capacity of the oil wedge between gear tooth surfaces. 3. Suggested features of the lubricants and gear materials which may be improved upon to give higher tooth load-carrying capacities. The important twelve points emphasized in this paper are listed for convenience in outline form and presented for study and analysis. No attempt is made here to give complete solutions of the problems at hand.

FUNDAMENTALS OF WORM GEAR LUBRICATION
Purdy, A. R.—pp. 20-27

The fundamentals of lubrication of worm gears are discussed. The investigations carried out have shown that no single lubricant possesses all the desirable characteristics for all classes of worm gear service. It is evident that speed, pressure, temperature, oil viscosity, and contact pattern are major factors in lubricating worm gears. As a result of these factors, worm-gear lubrication divides itself into three classifications: 1. Fluid film lubrication that requires straight mineral oil. 2. Boundary lubrication that requires a polar-type oil for normal loading, and a mild extreme-pressure type lubricant for heavy loading. 3. Metal-to-metal contact that at present is not successfully lubricated at all.

Erdöl und Kohle, Vol. 3, No. 3, March, 1950

INFLUENCE OF METALS ON FRICTION VALUE OF LUBRICATING MATERIALS
Jentzsch, H.—pp. 124-127

Friction develops heat and this may be cut down by use of the proper lubricant. When an unsuitable lubricant is used operating troubles result. The author describes a test method which gave reproducible values.

14.06 17.15

The Institute Spokesman, Vol. 13, No. 9, December, 1949

A CHAT WITH A STEEL MILL LUBRICATING ENGINEER
Hamilton, W. E.—pp. 11-15

In all the Tennessee Coal, Iron and Railroad Company's mills using oil circulating systems for bearing or gear lubrication, the company furnishing the equipment sets up specifications on the lubricant, usually without thought as to what lubricants the purchaser is already stocking and using. The author contends that too fine a line is drawn as to specifications. As an example he goes into strip mill lubrication. Different mills use different oils, but the author contends that all could have been designed to use an oil of the same viscosity. There has been talk also of an all-purpose grease. This is a large but attractive order. In the various operations there are many applications that call for all the ingenuity at the command of the grease manufacturer, to make a grease to satisfactorily do the job.

Iron Age, Vol. 165, No. 9, March 2, 1950

CUTTING OIL RECLAMATION PAYS OFF
Baur, S.—pp. 90-93

Cutting oil purification installations in metalworking plants produce substantial yearly dollar savings through quantities of oil reclaimed, man-hours saved, increased tool and machine life, and higher scrap prices paid for clean, dry, crushed chips. Complete installations usually include dry chip preparation setups integrated with centrifugal oil purification systems. Most installations of this type pay for themselves within one to three years.

14.064 14.066

Journal of the Institute of Petroleum, Vol. 35, No. 308, August, 1949

THE HYDRODYNAMICAL THEORY OF FILM LUBRICATION
Cope, W. F.—p. 292A
(Proc. Roy. Soc., A, Vol. 197, No. 1049, June 7, 1949, p. 201)

The equations of film lubrication are derived from the general equations of hydrodynamics, assuming only that the motion is steady, and that it takes place between two surfaces which are both close together and nearly parallel in relative motion. It is shown that film lubrication is possible if, and only if, either the distance between the surfaces decreases in the direction of motion (the geometric wedge), or the density of the fluid decreases in the same direction (the thermal wedge).

THE LOAD-CARRYING CAPACITY OF HYDRODYNAMICAL OIL FILMS. A REVIEW OF SOME CURRENT PROBLEMS
Anon.—pp. 292A-293A
(Mech. World, Vol. 128, No. 3253, May 20, 1949, p. 587)

Theoretical studies indicate that the load-carrying capacity of a journal bearing should be infinite. This is not the case in practice, and under certain conditions of bearing operation the load-carrying capacity may become substantially zero. Variations of viscosity of oil with temperature and (slightly) with pressure, the effect of surface conditions and the effect of load conditions are discussed.

JOURNAL BEARING LUBRICATION AND DESIGN
Thomson, A. S. T.—p. 293A
(Proc. Instn. Mech. Engrs., Vol. 158, No. 2, 1948, pp. 250-254)

Results are summarized of an investigation on the lubrication and design of journal bearings. Experiments are described in which high-point contact at starting and stopping is eliminated by supplying oil to a groove in the loaded side of the bearing at a pressure sufficiently great to overcome the applied load. The effect of a groove on the loaded side of the brass under various conditions of lubrication is investigated.

Vol. 35, No. 310, October, 1949

SIMPLE PRESSURE LUBRICATOR
Anon.—pp. 356A-357A
(Gas Oil Pwr., Vol. 44, 1949, p. 183)

The lubricator described has adjustable individual feeds to a total of six, is automatic in action, and oil is delivered without recourse to ball valves and springs. It is suited to oil-engines, tractors, compressors, etc.

Lubrication (The Texas Company), Vol. 36, No. 4, April, 1950

Anon.—pp. 37-48
STEAM POWER PLANT AUXILIARIES

Lubrication of steam power plant auxiliaries can be studied according to the type of lubricating system employed. Inasmuch as the latter is basic, and very often applied to more than one type of machine in the plant, the choice of lubricants is simplified and the number of required lubricants is reduced. Usually, it is advantageous to use the power generating equipment lubricants wherever practicable. Likewise, the turbine oil used for turbogenerator bearings is excellent on ring-oiled motor and blower bearings. More specialized lubrication, however, is involved in worm gear lubrication on stoker or pulverizer drives, or in air com-

(*Continued on page* 183)

OILS AND LUBRICANTS PATENT ABSTRACTS

Drying Oils and Process of Making Same From Clay Tower Polymers—Patent #2,505,-148—Valerie Schneider, assignor to Phillips Petroleum Co.

The process of producing a drying oil which comprises: distilling polymer liquid formed in a clay tower process for treating vapors of a petroleum fraction in the manufacture of gasoline; removing substantially all substances boiling below 400 F. from said polymer liquid as an overhead product; and separating the kettle product resulting from such distillation into a naphthalene-rich fraction and a naphthene-rich fraction suitable for use as a drying oil by use of a selective solvent at a temperature in the range from 22 F. to 40 F.

Grease — Patent #2,505,222 —Alfred W. Weitkamp and John C. Stamm, assignors to Standard Oil Co.

The method of preparing a rosin soap grease comprising heating a mixture of a hydrocarbon oil, rosin, and a modified rosin of the group consisting of dehydrogenated rosin, hydrogenated rosin, and mixtures thereof, at a temperature of from about 150 F. to about 300 F. to effect the solution of said rosin and said modified rosin in said hydrocarbon oil, and subsequently saponifying the solution of oil, said rosin and said modified rosin with a saponifying agent, selected from the group consisting of an alkali metal base, and alkaline earth base, and mixtures thereof, said rosin and modified rosin being used in the ratio of from 6:1 to about 1:4.

Screen Oil—Patent #2,505,740—William C. Morris and Samuel Z. Cardon, assignors to The Harshaw Chemical Co.

A screen oil composition essentially consisting of a solvent and at least 2% by weight of a polybutene of molecular weight from 40,000 to 120,000, the solvent constituting at least about 71.4% but not more than 96% of the composition by weight and a proportion of the solvent amounting to at least about 56% of the said composition by weight being a terpene solvent, said composition also containing as a plasticizer a resin of consistency at room temperature from that of a soft solid to that of a viscous liquid and selected from the group consisting of the methly, ethyl and glycebol esters of rosin acid and hydrogenated rosin acid, and copaiba balsam.

Lubricant—Patent #2,506,049—George R. Waitkins, assignor to Battelle Memorial Institute.

An improved mineral oil composition comprising a major amount of a mineral oil and a minor amount sufficient to stabilize the oil against oxidation of an oil-soluble compound selected from the group consisting of alkyl, alkaryl, aralkyl, and aryl selononophosphates.

Lubricating Oil Composition—Patent #2,-506,310—Louis A. Mikeska, assignor to Standard Oil Development Co.

A mineral lubricating oil containing about 0.02% to about 3% of a metal salt of an organo-substituted thiophosphoric acid obtained by reacting phosphorus pentasulfide with a mixture of wax-phenol and an aliphatic alcohol, the amount of phosphorus pentasulfide being the equivalent to at least 1 molecule for each 4 hydroxyl groups in the wax-phenol and alcohol present, at a temperature of 50 C to 150 C.

Lubricating Oil Compositions — Patent #2,506,570—Harry J. Andress, Jr., assignor to Socony-Vacuum Oil Co., Inc.

An improved mineral oil composition comprising a mineral oil fraction having in admixture therewith a minor proportion, sufficient to inhibit said oil fraction against oxidation, of an acidic, phosphorus- and sulfur-containing reaction product of a wax-substituted phenol obtained by: reacting one molar proportion of phosphorus pentasulfide with a wax-substituted phenol containing about two molar proportions of phenol at a temperature within the range of from about 100 C. to about 200 C. in the presence of a Friedel-Crafts catalyst and treating the reaction mixture thus formed with a small amount, from about 1 per cent to about 2 per cent, of Zinc dust based on the amount of wax-substituted phenol used in the reaction and a small amount of water.

Printed copies of patents are available from the Patent Office at twenty-five cents each. Address the Commissioner of Patents, Washington, D. C., for copies and for general information concerning patents.

From Official Gazette—Vol. 633, No. 4; Vol. 634, Nos. 1, 2, 3, 4, 5; Vol. 635, Nos. 1, 2, 3, 4.

Prepared by ANN BURCHICK

Lubricant Composition — Patent #2,506,-572—John D. Bartleson, assignor to The Standard Oil Co.

A mineral lubricating oil containing an amount of an additive to inhibit corrosion, lacquer and sludge formation when the oil is used in an internal combustion engine, said additive being the reaction product of reacting 0.5 to 2.5 mols of a phosphorus sulfide and 1 mol of a saturated amine having at least 12 carbon atoms in the molecule and at least one hydrogen directly attached to the nitrogen at a temperature in the range of 100 F. to 600 F. and reacting therewith an amount of a nitrogen base within the range of 0.25 to 6.0 equivalents per mol of the phosphorus sulfide, to form an oil dispersible reaction product suitable for addition to a lubricating oil.

Lubricant Composition— Patent #2,506,-573—John D. Bartleson, assignor to The Standard Oil Co.

A lubricant comprising an oil dispersible reaction product of 1 mol of an unsaturated organic amine of 12 to 18 carbon atoms having at least one olefinic double bond and having at least one amine hydrogen and 0.3 to 2.5 mols of a phosphorus sulfide reacted at an elevated temperature, which contains an added element of the sulfur family reacted therein at a temperature in the range of 200 F. to 300 F.

Lubricants— Patent #2,506,597 — Everett C. Hughes and John D. Bartleson, assignors to The Standard Oil Co.

A lubricating composition comprising an oil dispersible reaction product of a saturated aliphatic ketone having at least 12 carbon atoms with a sulfide of phosphorus subjected to at least one stage in its manufacture to a temperature of at least 400 F. and below a temperature up to 600 F. at which the reaction product would be decomposed, and having an added element of the sulfur family reacted therein at a temperature in the range of 100 F. to 500 F.

Process for Preparing Addition for Mineral Oil Lubricants, The Agents So Obtained, and Mineral Oil Lubricants Containing Them —Patent # 2,506,900 — Herschel G. Smith and Troy L. Cantrell, assignors to Gulf Oil Corp.

The process of preparing an addition agent for mineral oil lubricants which comprises simultaneously reacting at a temperature ranging from room temperature to 350 F. an octyl phenol with from 0.5 to 30 per cent by weight on the octyl phenol of a sulfur chloride and from 0.1 to 5 per cent by weight on the octyl phenol of phosphorus sesquisulfide.

Addition Agents for Mineral Oil Lubricants and Compositions Containing the Same —Patent #2,506,901—Hershel G. Smith and Troy L. Cantrell and John G. Peters, assignors to Gulf Oil Corp.

The process of preparing an addition agent for mineral oil lubricants which comprises simultaneously reacting at a temperature ranging from room temperature to 350 F. an octyl phenol with from 0.5 to 30 per cent by weight of the octyl phenol of a sulfur chloride and from 0.1 to 5 per cent by weight of the octyl phenol of phosphorus sesquisulfide, neutralizing the reaction product obtained thereby with aluminum hydroxide to obtain a substantially neutral reaction product, condensing the neutral reaction product with formaldehyde by heating at a temperature not greater than 275 F. the neutralized reaction product and from 0.5 to 2 mols of formaldehyde per mol of octyl phenol used in making said reaction product.

Addition Agents for Mineral Oil Lubricants and Compositions Containing the Same — Patent #2,506,902 — Herschel G. Smith, Troy L. Cantrell and John G. Peters, assignors to Gulf Oil Corp.

The process of preparing an addition agent for mineral oil lubricants which comprises simultaneously reacting at a temperature ranging from room temperature to 350 F. an octyl phenol with from 0.5 to 30 per cent by weight of the octyl phenol of a sulfur chloride and from 0.1 to 5 per cent by weight of the octyl phenol of phosphorus sesquisulfide, forming a neutral stannous salt of the reaction product, and condensing the neutral stannous salt at an elevated temperature not exceeding 275 F. with from 0.5 to 2 mols of formaldehyde per mol of octyl phenol used in making said reaction product.

Stabilized Lubricating Grease Compositions — Patent #2,506,905 — Herschel G. Smith and Troy L. Cantrell, assignors to Gulf Oil Corp.

A grease composition comprising a mineral lubricating oil thickened to a grease by a soap, and a small amount of a substantially neutral higher fatty mono-carboxylic acid ester of a fusible, soluble mono-alkylated phenol-formaldehyde condensation product, the higher fatty acid being selected from the class consisting of saturated and mono-olefinic fatty acids having at least 8 carbon atoms, and the alkyl substituent of the alkylated phenol having from 4 to 12 carbon atoms, said ester being present in an amount sufficient to retard oxidation of the grease.

Stabilized Lubricating Grease Compositions —Patent #2,506,906—Hershel G. Smith and Troy L. Cantrell, assignors to Gulf Oil Corp.

A grease composition comprising a mineral lubricating oil thickened to a grease by a soap and a small amount of a substantially neutral condensation product of formaldehyde and a higher fatty monocarboxylic acid ester of a mono-alkylated phenol, the higher fatty acid being selected from the class consisting of saturated and mono-olefinic fatty acids having at least 8 carbon atoms and the alkyl substituent of the alkylated phenol having from 4 to 12 carbon atoms, said condensation product being present in an amount sufficient to retard oxidation of the grease.

Solvent Refining of Light Oils — Patent #2,507,861—Robert E. Manley, assignor to The Texas Company.

A method of producing Diesel fuel oil from residual crude oil relatively high in sulfur and nitrogen-containing compounds, said sulfur content being in excess of 1% by weight, which comprises subjecting said reduced crude to heating at a temperature of about 800 F. to 850 F. while under super atmospheric pressure such that the feed oil undergoes thermal cracking sufficient to reduce substantially its viscosity, distilling from the thermally cracked crude a fraction boiling in the range of gas oil, subjecting said gas oil fraction while in vapor phase to contact with a fluidized alumina-silica cracking catalyst at a temperature of about 960 F. and under about atmospheric pressure such that at least about 50% by volume of the gas oil is converted into gasoline and lower boiling material, fractionating from the products of catalytic cracking a second gas oil fraction, subjecting this second gas oil fraction to solvent extraction with furfural saturated with water at a temperature of about 77F.-90F., such that raffinate oil and extract oil fractions are formed, withdrawing said raffinate oil fraction and stripping residual solvent from the withdrawn fraction thereby obtaining solvent-free raffinate oil substantially free from nitrogen, containing not in excess of about .016% sulfur and having a relatively high cetane number.

Lubricating Oil for Use in Rolling Metal —Patent #2,508,016—Paul Joseph Doyle and Charles Herman Flickinger, assignors to Republic Steel Corp.

A composition of matter possessing cold metal reducing lubricity and consisting essentially of an unoxidized aliphatic hydrocarbon mineral oil containing oxidized hydrocarbons having between about 6 and about 18 carbon atoms per molecule and between about 0.01% and about 2.0% of oxygen existing essentially as organic acids, alcohols and esters of relatively high

molecular weight substantially free from aldehydes and ketones, having a viscosity of from about 95 seconds to about 605 seconds at 100 F. as determined by the Universal Saybolt procedure, having an acidity value of from about 0.05 mg. to about 5.0 mg. of KOH, as determined by the ASTM Standard Neutralization Test and having less than about 0.5% residual carbon.

Colored Lubricating Oil—Patent #2,508,-617—Robert G. Mastin, assignor to Cities Service Oil Co.

A petroleum lubricating oil stock containing a small proportion sufficient to impart a greenish fluorescence to the oil stock of a product obtained by reacting phenylhydrazine at a temperature of about 100 C. with an approximately equimolar quantity of a reagent selected from the group consisting of dianisalacetone, anisalcinnimalacetone, and dicinnimalacetone, in acetic acid solution.

Lubricating Grease Composition—Patent #2,508,741—Harry V. Ashburn and Robert S. Barnett and Oney P. Puryear, assignors to The Texas Co.

A lubricating grease composition comprising as the lubricant base and the major constituent of the composition a synthetic high boiling liquid polyorganosiloxane within the lubricating oil viscosity range, and sufficient metal soap of a soap-forming fatty material selected from the group consisting of hydroxy fatty acids and hydroxy fatty acid glycerides to thicken said lubricant base, said grease composition being texture stable under high shearing stress.

Emulsifiable Oil Concentrates of Biological Toxicants—Patent #2,509,233—Russell A. Kaberg and John S. Harris, assignors to Monsanto Chemical Co.

A water-dispersible concentrate for forming stable oil-in-water emulsions comprising an aromatic oil boiling within the range of 176 F. to 570 F.; a biological toxicant soluble in said aromatic oil; from 3 to 10% by weight of an oil-soluble organic surface-active agent which is a neutral salt and which is selected from the group consisting of sulfonates and sulfates and having a Draves wetting time of less than 10.5 seconds in an aqueous solution consisting of 0.5% by weight of said surface-active agent; and from 3 to 10% by weight of the non-resinous condensation product of 1 part of a substance selected from the group consisting of abietic acid, abietic anhydride, isomers of abietic acid, salts of abietic acid, esters of abietic acid, resin acids, rosin, rosin oil and tall oil, with at least 0.5 part and less than 5 parts by weight of ethylene oxide.

Polymer Compositions—Patent #2,510,112—George E. Holbrook, assignor to E. I. duPont deNemours & Co.

The process which comprises mixing an aqueous dispersion of colloidal polymerized tetrafluoroethylene, containing from about 25% to about 75% by weight of the polymer, with a substantially completely fluorinated hydrocarbon oil, distilling at temperatures in the range of from about 50 C. to about 300 C. at 10 mm. Hg pressure, employing from about 0.25 to about 9 parts by weight of fluorinated oil to each part of polymer, coagulating the aqueous dispersion while stirring the mixture, then settling the mixture, and separating the mixture, and separaing the suspension of colloidal polymer in fluorinated oil from the aqueous phase.

Certain Oxyalkylated Blown Oils and Method of Making Same—Patent #2,510,-335—Melvin De Groote and Bernhard Keiser, assignors to Petrolite Corp., Ltd.

An oxyalkylated, drastically-oxidized oiticica oil-castor oil condensate, said condensate being obtained by a reaction within the temperature range of 250 C. to about 280 C. in the presence of an acid sulfate activating agent; the proportion of oiticica oil to castor oil being within the range of one part of castor oil to two parts of oiticica oil, up to five parts of castor oil to two parts of oiticica oil; said oxidation being by means of a gaseous oxygen-containing medium and said oxyalkylation being sufficient to endow the final product with distinctly hydrophile properties and with the final proviso that the oxalkylating agent be selected from the class consisting of ethylene oxide, propylene oxide, butylene oxide, glycide, and methyl glycide.

Preparation of Break-Free Glyceride Oils—Patent #2,510,379—Roger M. Christenson, assignor to Pittsburgh Plate Glass Co.

A method of treating oil containing break constituents for purposes of overcoming a tendency to produce break, which process comprises treating the oil with an alkali, then further treating the oil with a strong acid in an amount approximately equivalent to the total alkali with which the oil was treated and subsequently removing the resultant salt of the alkali and the acid.

Synthetic Lubricant—Patent #2,510,540—Seaver A. Ballard, Rupert C. Morris and John L. Van Winkle, assignors to Shell Development Company.

An oleaginous oleophilic mixture of homopolymeric ethers of 1,2-epoxy linear hydrocarbons, suitable for use as a lubricating composition, said epoxy hydrocarbons containing from 4 to 14 carbon atoms and bearing only hydrogen atoms and an epoxide ring on the 1,2-positions.

Stabilized Extreme Pressure Lubricants—Patent #2,511,250—Jack S. Fawcett, assignor to Gulf Research & Development Co.

A stabilized extreme pressure lubricant consisting predominantly of a lubricating oil, an extreme pressure agent consisting of a halogenated hydrocarbon in an amount sufficient to impart extreme pressure characteristics and normally to impart corrosive properties, and a small amount, sufficient to inhibit said corrosive properties, of the triethanolamine salt of the oil soluble petroleum sulfonic acids.

Liquid Hydrocarbon Lubricant, an Additive Therefor, and a Process of Making the Additive — Patent # 2,511,630 — Mayer B. Goren and David E. Adelson, assignors to Shell Development Company.

A composition comprising a major amount of a lubricating liquid hydrocarbon and a minor amount sufficient to stabilize said lubricating liquid hydrocarbon against deterioration and improve its anti-wear properties of a stable, non-corrosive neutralized phosphorus and sulfur containing reaction product obtained by reacting at a temperature ranging from 130 C. to about 200 C. a phosphorus sulfide with an unsaturated cyclic ketone fraction having at least 12 carbon atoms and being an isophorone bottoms residual fraction having a minimum boiling point greater than 140 C. at 10 mm. Hg pressure, and derived from condensation of acetone to higher molecular weight isophorone type fraction, the ratio of the phosphorus sulfide to the ketone compound being 1:4 to about 1:8, respectively, and neutralizing the reaction product with a basic reagent.

Extreme Pressure Lubricants — Patent #2,511,731—George M. McNulty and Elmer B. Cyphers, assignors to Standard Oil Development Co.

An extreme pressure additive for lubricant compositions consisting essentially of the condensation product, at a temperature within the range of 20 C. to 150 C., of approximately 1 part by weight of a chlorinated hydrocarbon selected from the class which consists of chlorinated kerosene and chlorinated wax, and about 9 parts by weight of a dialkyl dithiophosphoric acid alkali salt having 1 to 6 carbon atoms in each of the alkyl groups, said product having a chlorine content of between about 20 and 34% by weight.

Antioxidants for Mineral Oil Lubricants and Compositions Containing the Same — Patent #2,511,744—Hershel G. Smith, Troy L. Cantrell, and John G. Peters, assignors to Gulf Oil Corp.

The process of preparing an addition agent for mineral oil lubricants which comprises heating from 1 to 4 mols of a xylidine, 1 to 4 mols of N-dimethylaniline and 0.5 to 4 mols of formaldehyde per mol of xylidine in the presence of an activated clay catalyst at a temperature not in excess of 350 F. to condense together the three reactants, and recovering the condensation product.

Antioxidants for Mineral Oil Lubricants and Compositions Containing the Same — Patent #2,511,745—Hershel G. Smith, Troy L. Cantrell, and John G. Peters, assignors to Gulf Oil Corp.

The process of preparing an addition agent for mineral oil lubricants which comprises heating from 1 to 4 mols of diphenylamine, 1 to 7 mols of N-dimethylaniline, and 1 to 7 mols of formaldehyde in the presence of an activated clay catalyst at a temperature not in excess of 350 F. to condense together the three reactants, and recovering the condensation product.

Antioxidants for Mineral Oil Lubricants and Compositions Containing the Same — Patent #2,511,746—Hershel G. Smith, Troy L. Cantrell, and John G. Peters, assignors to Gulf Oil Corp.

A lubricant composition comprising a major amount of a mineral lubricating oil, and a minor amount, from 0.001 to 1.0 per cent by weight of said oil, of a non-resinous condensation product of 1 mol of N-amylaniline, 1 to 4 mols of N-dimethylaniline, and 1 to 4 mols of formaldehyde, said product being obtained by the process of claim 1.

Antioxidants for Mineral Oil Lubricants and Compositions Containing the Same — Patent #2,511,747—Hershel G. Smith, Troy L. Cantrell, and John G. Peters assignors to Gulf Oil Corp.

The process of preparing an addition agent for mineral oil lubricants which comprises heating a reactant mixture consisting of N-dimethylaniline and formaldehyde in the presence of an activated clay catalyst at a temperature not in excess of 350 F. to condense together the two reactants, and recovering the condensation product, the mol ratio of formaldehyde to N-dimethylaniline ranging from 0.5:1 to 10:1.

Antioxidants for Mineral Oil Lubricants and Compositions Containing the Same — Patent #2,511,748—Herschel G. Smith, Troy L. Cantrell, and John G. Peters, assignors to Gulf Oil Corp.

The process of preparing an addition agent for mineral oil lubricants which comprises heating 1 mol of an N-diethyltoluidine with from 0.5 to 1 mol of formaldehyde in the presence of an activated clay catalyst at a temperature not in excess of 350 F. to condense together the reactants, and recovering the condensation product.

Antioxidants for Mineral Oil Lubricants and Compositions Containing the Same — Patent #2,511,749—Herschel G. Smith, Troy L. Cantrell, and John G. Peters, assignors to Gulf Oil Corp.

The process of preparing an addition agent for mineral oil lubricants which comprises heating from 1 to 4 mols of an N-diethyltoluidine, 1 to 4 mols of N-dimethylaniline, and 1 to 4 mols of formaldehyde in the presence of an activated clay catalyst at a temperature not in excess of 350 F. to condense together the three reactants, and recovering the condensation product.

Antioxidants for Mineral Oil Lubricants and Compositions Containing the Same — Patent #2,511,750—Herschel G. Smith, Troy L. Cantrell, and John G. Peters, assignors to Gulf Oil Corp.

The process of preparing an addition agent for mineral oil lubricants which comprises heating 1 mol of N-diethylaniline with from 1 to 6 mols of N-dimethylaniline, and 1 to 6 mols of formaldehyde in the presence of an activated clay catalyst at a temperature not in excess of 350 F. to condense together the three reactants, and recovering the condensation product.

Lubricant Compositions Containing Beryllium Carboxylates — Patent #2,512,359 — John F. McGrogan, assignor to The Atlantic Refining Co.

A lubricating oil composition comprising hydrocarbon oil and a beryllium salt of a carboxylic acid containing from 6 to 18 carbon atoms, said salt being present in an amount sufficient to improve the detergency of the oil when used in the lubrication of internal combustion engines.

Antioxidants for Mineral Oil Lubricants and Compositions Containing the Same— Patent #2,512,444—Herschel G. Smith, Troy L. Cantrell, and John G. Peters, assignors to Gulf Oil Corp.

The process of preparing an additive agent for mineral oil lubricants which comprises adding an activated clay catalyst, from 1 to 2 mols of methyl ether of amylphenol with from 1 to 2 mols of N-dimethylaniline and 1 to 2 mols of formaldehyde per mol of methyl ether of amyphenol to a mineral lubricating oil, heating the mixture to a temperature not in excess of 350 F. to form a condensation product of the three reactants, and recovering a solution of the condensation product in the mineral lubricating oil.

Antioxidants for Mineral Oil Lubricants and Compositions Containing the Same — Patent #2,512,445—Herschel G. Smith, Troy L. Cantrell, and John G. Peters, assignors to Gulf Oil Corp.

The process of preparing an addition agent for mineral oil lubricants which comprises heating phenyl salicylate with from 1 to 4 mols of N-dimethylaniline and 1 to 4 mols of formaldehyde per mol of phenly salicylate in the presence of an activated clay catalyst at a temperature not in excess of 350 F. to condense together the three reactants, and recovering the condensation product.

(*Continued on page* 186)

Book Reviews

Kent's Mechanical Engineers' Handbook —12th Edition

Power Volume—J. Kenneth Salisbury, Editor.
John Wiley and Sons, New York, 1950. 1409 pages. Price $8.50.

Design and Production Volume—Colin Carmichael, Editor.
John Wiley and Sons, New York, 1950. 1611 pages. Price $8.50.

It is always an event in the engineering publishing world when a new edition of Kent's Handbook appears. This standard reference book for mechanical engineers, which is now in its 12th edition, no longer is actively under the editorship of one of the Kent family, as Mr. R. T. Kent passed away during the early stages of revising the Handbook, and two new editors took over the revision and capably carried the revision to completion. Both of the volumes bring to the forefront the latest engineering practice and have been greatly expanded over the previous editions.

Power Volume

The Power Volume is divided into 20 sections, each under the authorship of a distinguished authority in the field under discussion. These sections cover the whole gamut of power engineering, ranging from thermodynamic characteristics of air and vapors to hydrodynamics, steam turbines and engines, gas turbines, refrigeration, heating and air conditioning, electric power, instrumentation, test codes and numerous other topics. The book contains a wealth of tabular data, with numerous illustrations and graphs. As a reference book it merits a place in the library of every mechanical engineer.

Design and Production Volume

The Design and Production Volume consists of 28 sections, prepared by many authors, covering such topics as properties of materials, corrosion, fasteners, springs, machine hydraulics, gearing, metal working, materials handling, control mechanisms, bearings and lubrication and other items too numerous to mention here. The section on bearings and lubrication is particularly extensive, covering 111 pages and ranging from lubrication fundamentals to a variety of applications and varying types of bearings. In addition, the properties of lubricants are considered in some detail. Both the tabular and illustrative material in this volume are presented on a very fine plane and are remarkably complete.

YOU CAN'T AFFORD
NOT TO USE...
PLASTILUBE
THE SUCCESSOR TO GREASE
In 4 short months, over 900 cost-and-quality-minded firms have bought and now specify PLASTILUBE, the successor to grease (compounded with Warren's I-45 and BENTONE, a product of National Lead Co.)
★ NEVER MELTS
★ MULTI-PURPOSE
★ COSTS LESS IN USE
You can't afford NOT to use PLASTILUBE... place your order or write for full details today!
Our 50th Anniversary Year
THE Warren REFINING & CHEMICAL COMPANY
CLEVELAND 15, OHIO

Motor Oils and Engine Lubrication

By Carl W. Georgi, Quaker State Oil Refining Company.

Reinhold Publishing Company, New York, 1950. 514 pages. Price $8.50.

Mr. Georgi, as technical director of the research laboratories of the Quaker State Oil Refining Company, is in a fine position to write this volume. The volume presents in detail much information on lubricant characteristics and the various tests used with lubricants.

A whole chapter in the book is devoted to viscosity and viscosity index. Chapters are also devoted to the refining of oil and the use of additives with detailed analyses of how motor lubrication systems should be designed and how sludge can be kept to a minimum. Valuable information is given to help diagnose engine ailments.

This book is primarily a reference book for lubrication engineers, automotive service engineers, engine designers and for people in technical service and sales departments.

B. H. JENNINGS

Bound Volumes

LUBRICATION ENGINEERING

Vol. 4 (1948) Only

50 Copies

Durable Cloth Binding
Stamped in Gold

Available at Cost

$5.00 POSTPAID

343 S. Dearborn St.
Chicago 4, Ill.

"Catsup ON YOUR ICE CREAM?"

Just because you used catsup on your steak, the waiter shouldn't assume you use it on the rest of your dinner too!

And just because one bearing is best lubricated by one particular grade of oil, you shouldn't assume that the same oil is best for *all* bearings on that machine. In many cases it isn't.

OIL CUPS permit you to lubricate each bearing with the oil best suited to that bearing—thus prolonging bearing life, reducing maintenance costs, cutting down-time, boosting production. And oil cups fortunately *cost very little.*

Gits oil cups have been the standard for industry for more than 40 years. Gits Bros. has the largest selection of oil cups available anywhere. Call on Gits Bros. for a prompt, efficient solution to your lubrication problems.

Write for free Price Guide Catalog

GITS BROS. MFG. CO.

1876 S. Kilbourn Ave. • Chicago 23, Ill.

TESTED LUBRICANTS FOR ALL APPLICATIONS

Industrial -- Automotive

STEAM ENGINES
DIESEL ENGINES
TURBINES • COMPRESSORS
METAL WORKING
MINING
CONSTRUCTION MACHINERY
AUTOMOTIVE EQUIPMENT

SINCLAIR

SINCLAIR REFINING COMPANY

630 FIFTH AVENUE • NEW YORK 20, N. Y.

"The Lubrication Engineer"

(*Continued from page* 170)

(h) *Standardization*

Emphasis is continually being directed towards standardization of equipment. Much ground has been covered in this direction by the technical institutions and other bodies. The advantages to be gained by standardization are briefly: —

(i) conformity and uniformity,
(ii) improvement in replacement difficulties,
(iii) ease of reference to specification,
(iv) reduction in multiplicity of spares carried.

The Lubrication Engineer should endeavor to standardize lubricating equipment fittings on his own plant. The Drawing Office should be issued with such a list so that there will be no confusion, at the drawing stage, as to the type of equipment to specify for lubricating any particular class of machines.

Further, manufacturers may be issued with specifications concurring with agreed standards on any piece of machinery under order. In special cases it is advisable that the Lubrication Engineer "vet" machinery before despatch by the maker.

(i) *Cost figures*

Finance is the greatest influence in any business and is, therefore, the biggest weapon available to the Lubrication Engineer. He is bound to come up against opposition in his attempts to show the justification of any steps he might take. If, during the initial period of his work, a saving on maintenance, power, and lubricant costs is evident then further improvements are justifiable and will receive support.

He should, therefore, maintain up-to-date cost records so that he has at his finger tips an answer to the question "what are you saving." Such cost figures should always be based on tonnage output to give a true picture.

(j) *New developments in petroleum*

In order to keep up with new developments in petroleum and lubricating equipment the Lubrication Engineer should study information issued by the approved Institutions, technical literature, etc., and advise on any aspects which could be applied to advantage.

Future Prospects

Having referred to the aims of the Lubrication Engineer let us briefly consider his future prospects both in the steel and other industries.

Although the steel industry has shown the way, there is no limit to the field of operation or use of lubrication. The complicated machinery of the textile trade, the multiplicity of machine tools in all production processes, power stations, the chemical and food industries, agricultural machinery, transport undertakings, mining and related industries, pulp, paper, and stationery manufacturers, all these lend themselves to improvement through efficient lubrication.

The field of vision of the Lubrication Engineer is thus very wide, indeed, and though as yet numerically small in this country, he is firmly established. Industry must realize his value through his own efforts for by not being satisfied until the best is achieved his development in all spheres will be ensured.

(*Continued from page* 167)

of the cutting fluid to that element and chemical reaction with it, before it is out of contact. At such cutting speeds then, the benefits of friction reduction are lost. However, as cutting speed is increased, cutting temperatures increase rapidly. As high speeds are approached, then, the benefits of good cooling action by the cutting fluid become increasingly important. Thus, at speeds above about 50 feet per minute, the need for good cooling ability in a cutting fluid becomes very important. Over the normal range of conditions used in the machining of metals, good cooling, and good friction reduction must go hand in hand if a cutting fluid is to perform its job effectively.

Conclusion

While it is evident from the above that much has been learned in recent years about the action of cutting fluids in machining, it is also evident that much yet remains to be learned. The gap between the possible and the actual performance of cutting fluids in practice is still very wide. The frontiers for expansion of our knowledge of the physics and chemistry of cutting fluid action and the metal cutting process seem practically limitless. It is by the expansion of such frontiers, through continuing research, that further major advances in cutting fluid performance can be expected to come.

Acknowledgements

The author wishes to acknowledge the important contributions made by Mr. Hans Ernst, Research Director, to theory and experiment in the work on metal cutting and cutting fluids described in this paper, and by Dr. Milton C. Shaw, whose theoretical and experimental work, carried on while a member of our laboratory staff, contributed greatly to the picture of the mechanism of cutting fluid action described here.

*The fact that water maintains a high cutting ratio at very high cutting speeds is not due to the fact that it is providing effective friction reduction at those speeds. Actually, the cutting ratio is a function not only of chip friction but also of the plastic properties of the metal being machined. The very good cooling provided by water at very high cutting speeds actually changes the plastic properties of the metal favorably, so that the cutting ratio remains higher than that for dry cutting.

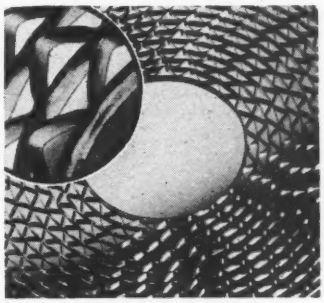
The fact that benzene (benzol) gives a cutting ratio value slightly lower than that for dry cutting is due to the fact that with "dry" cutting air is actually present as a cutting fluid; some slight friction reduction is brought about by the oxides formed at the chip-tool interface. Benzene, a pure hydrocarbon, is completely inert chemically toward the chip metal and in addition excludes all air; this prevents the formation of any oxide film, or any other protective film, at the interface. Friction is thus a maximum when benzene (or other pure hydrocarbons) is used as the cutting fluid.

MAGNETIC FILTERING

What it is!
What it means to your Circulating Oil Systems!

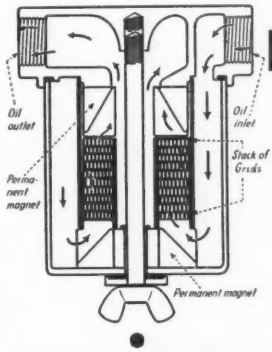
Magnetic separation for the elimination of iron and steel particles makes a *big* difference in the life of machinery which use circulating oil systems. The Frantz Permanent Magnet FerroFilter is fundamentally different from the conventional type of filter. Its patented design consists essentially of layers of soft steel grids, placed between and magnetized by two powerful permanent magnets.

These grids have triangular mesh openings which may range from .5" down to .15" in width. The hundreds of feet of strongly magnetized grid edges comb and recomb the flowing oil, splitting the flow streams into thin elements and forcing each particle of iron, steel, scale, etc. to pass very close to them. Many of the larger iron particles immediately adhere to the magnets while the finer particles are snared by the grid stacks. This dual action gives an extremely high efficiency of removal, recovering from suspension particles even as small as a micron in size.



A FERROFILTER GRID
Magnified inset shows collected particles on grid edges.

The Frantz FerroFilter is in successful operation in hundreds of small plants, large plants, and great plants. Send now for our bulletin No. 50 for complete information.



FRANTZ FERROFILTER

- *Catches ferrous particles as fine as one micron*
- *No replacement parts to buy*
- *Full flow and non-clogging*
- *Easily attached*
- *All parts easily accessible and quickly cleaned*

S. G. FRANTZ CO. INC.
BOX 1138
TRENTON, N. J.

LUBRICATION DAN SEZ:

We didn't discover the Drake Well in 1859 . . . but

just 17 years later (1876) our company was founded

in these 74 years— tremendous experience, constant laboratory research, close study of industrial lubricant problems have resulted in the development of

*** LEADOLENE Klingfast**

. . . and one of our good customers recently DISCOVERED that they had better protection, and the consumption of Leadolene KLINGFAST was just *one-fifth* the quantity of a high grade lubricant they had been using previously—on enclosed table roller gear housings of a continuous plate mill. Leadolene KLINGFAST *can do a better protective job for you, too, more economically,* under such difficult conditions as climatic changes, excessive water and abrasive conditions. Our engineers will be glad to work with you.

CHECK THESE 9 IMPORTANT FACTS:

1. **EXTREME PRESSURE pH-ilm STRENGTH** of 50,000 lbs. per square inch minimum by "Timken" testing machine.
2. **ADHESIVENESS** in which affinity for steel and other metals develops maximum adhesion and prevents drippage or creeping. Retains a flexible coating in nature.
3. **WATER REPELLENCE** which retards washing off, creates a lubricating pH-ilm under moisture or water conditions.
4. **CORROSION PREVENTION** is an excellent protective coating in that it will not etch or corrode metals. Is never acidic.
5. **COMPOUNDED STABILITY**— Will not bleed or change physical condition within range of higher than usual temperatures for this type of lubricant.
6. **LOW TEMPERATURE FACTORS**—While having a solidifying action by decreased temperature as low as —40 F., it does not harden, crack or decrease in adhesion. The flexible coating withstands distortion of the application.
7. **ABRASIVE RESISTANCE**—Extremely high for a lubricant. Does not wipe off nor will be removed in handling by workmen's hands or gloves. Is extremely repellent to adhesion of scale, metallics and other forms of dusts or contamination.
8. Klingfast has remarkable corrosive resistance to salt or sea water, acidic vapors and solutions.
9. Klingfast can be removed by ordinary solvents such as kerosene, gasolene, naphtha, carbon tetrachloride and similar substances but is highly impervious to lubricating oils and greases.

*LEADOLENE . . . the "I. P. Lubricant" (Indestructible pH-ilm) . . . for Industrial Needs

The Brooks Oil Co.

Since 1876

Pittsburgh 12, Pennsylvania
Cleveland, Ohio
Hamilton, Ontario

Warehouses: In Principal Industrial Cities

STOP COSTLY Upper Cylinder WEAR with the UNIVERSAL TOP OILER

★★

Used on all internal combustion engines except diesel. Atomizes top cylinder oil and distributes it evenly to upper cylinder area. Stops excessive piston, ring, and cylinder wear caused by insufficient upper cylinder lubrication. Frees sticky valves, prevents gum formation, reduces oil and gas consumption. Quickly pays for itself because of lower repair bills and better engine performance. Furnished complete—installed in 30 minutes with easy-to-follow instructions. Approved by leading top oil marketers.

Only $8.95 Postpaid

Best Top Oiler Buy AT ANY PRICE

UNIVERSAL LUBRICATING SYSTEMS, INC.
690 Allegheny Avenue, Oakmont, Pa.

☐ Send UNIVERSAL Top Oiler at once. ☐ Send literature.

Name ..... Title .....

Company .....

Address .....

City ..... State .....

Studies Of The Load-Carrying Capacity Of Sleeve Bearings

(*Continued from page* 162)

The shaft surface roughness, within the range included in these tests, appears to be an unimportant variable.

Again, the results obtained were unexpected. It would have been easy to correlate these results with one's ideas of service behavior, if copper had failed badly under some particular condition. The explanation would then have been that this condition existed in service, and was the reason why copper could not be used. The results obtained do not permit such easy interpretation.

At present, only alternative and unsatisfactory explanations are permissible. These are: (1) That our concept that copper is a poor bearing material is completely wrong. (2) That some other factor which is significant in service has been omitted and, therefore, that ways of making bearing tests which correlate with service are not available to us or anyone.

The present situation is unsatisfactory, and work on this subject is continuing.

Acknowledgement

This study of fundamental bearing behavior is being made for the Office of Naval Research. The assistance of Dr. R. W. Dayton of Battelle, has been greatly appreciated.

Current Literature

(*Continued from page* 176)

pressor cylinder lubrication. They must be approached with due consideration of the temperature conditions and the abrasive effects should coal or ash dust work into the operating mechanisms. In fact, the operating conditions generally are the cause of lubrication problems.

14.06 36.00

***Lubrication Engineering*, Vol. 5, No. 5, October, 1949**

LABORATORY EVALUATION OF EP GEAR OILS

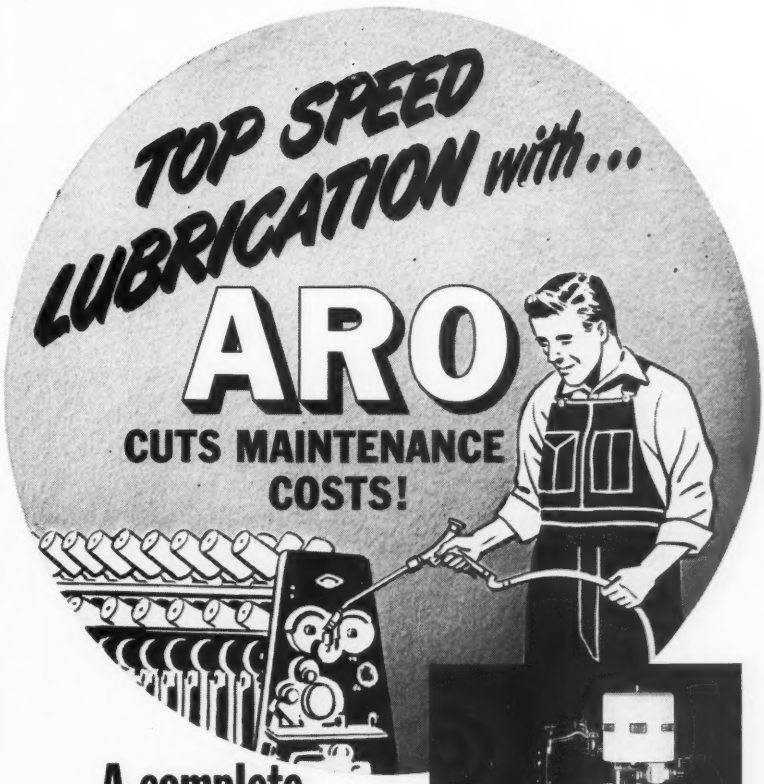
Sargent, L. B., Jr., Kolarik, I. S., and Kipp, E. M.—pp. 226-230

It is apparent from the data reported that limited correlation does exist between Falex machine and Four-Ball machine ratings. The fact that even the amount of correlation noted was found to exist is all the more significant in view of the fact that the oils were tested as a unit and that no attempt was made to further classify the oils according to viscosity groups, type of additive employed, etc. Other investigations have indicated that the Timken machine is extremely sensitive to viscosity variations within the viscosity ranges represented by the lubricants employed in this investigation. There appears, therefore, to be some reason to believe that further investigation of the effect of these variables upon the manner in which each machine rates a lubricant may be expected to further clarify the present confused picture as to why different lubricants appear to perform differently in various types of lubricant test apparatus. It is also significant to note that utilization of either the Four-Ball of the Falex machines alone would apparently have given essentially the same general relative rating as should have been obtained by the combined use of the Falex, Four-Ball, and Timken machines.

NON-FLAMMABLE HYDRAULIC FLUIDS

Murphy, C. M., and Zisman, W. A.—pp. 231-234

In addition to the properties normally required in hydraulic fluids such as lubricity, stability, adequate liquidus range, inertness to metals and packing materials, there is a need for a less flammable fluid to care for the fire hazards that are inherent in military and certain commercial hydraulic applications. The common flammability tests, spontaneous ignition temperature, flash and fire points were found to be incapable of predicting the relative flammabilities of fluids to the variety of fire hazards to which they may be exposed in service. Two new tests were developed, the incendiary fire and spray flammability tests. The relative flammabilities of a variety of fluids including petroleum oils, carboxylic and phosphate esters, glycols and derivatives, silicones, chlorinated and fluorinated compounds, and water-base fluids were studied using these methods. It was concluded that the hydrocarbon and carboxylic ester fluids were quite flammable. Increasing the proportions of oxygen, phosphorus and halogen constituents and the concentration of water in a fluid composition reduced the flammability. The action of fire-resistant additives like volatile "snuffers" and non-volatile "quenchers" is imperfectly understood. It is concluded that only three hydraulic fluids have been developed which are sufficiently flame-resistant: Hydrolubes, the hexachlorobutadiene-base fluid "A" and the chlorinated aromatic base fluid "PS." Only Hydrolube can be used

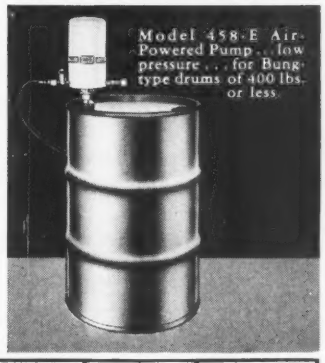


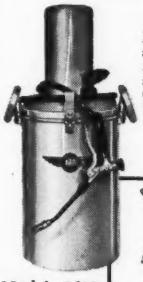
A complete line for industry—

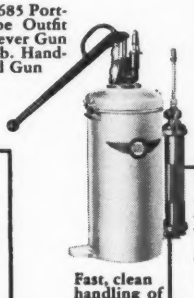
Correct lubrication is a *must* for the proper functioning of machinery in your plant! This means—use the right lubricants *and the right lubricating equipment!*

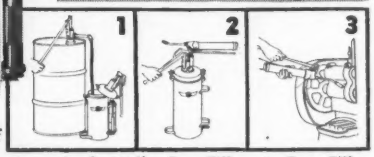
Do the job with Aro's expertly engineered complete line of lubricating equipment for top-speed and efficiency! Assures fast clean handling of lubricants . . . positive lubrication . . . with less labor and less waste . . . more production time for your machines . . . and lower maintenance costs! A few items in the Aro line are shown here. See your Aro Jobber or write . . . The Aro Equipment Corporation, Bryan, Ohio. Aro of Canada, Ltd., Toronto, Ont.

Model 51-DX twin cylinder High Pressure Lubricator . . . air-powered . . . for use with 100 lb. drums.


Model 458-E Air-Powered Pump . . . low pressure . . . for Bung-type drums of 400 lbs. or less.


Model 5690 Air-Powered Lubricator . . . available with 2-wheel Hand Truck or dolly for easy portability.


Model 5685 Portable Lube Outfit ...1 lb. Lever Gun and 30 lb. Hand-Operated Gun Filler.



Fast, clean handling of lubricants! 1—Transfer Pump loads 30-lb. Gun Filler; 2—Gun Filler loads 1-lb. Gun; 3—Gun applies lubricant.

ARO LUBRICATING EQUIPMENT

Also—AIR TOOLS . . . HYDRAULIC EQUIPMENT . . . AIRCRAFT PRODUCTS . . . GREASE FITTINGS

Manzel Force Feed Lubricators penetrate the maze to force just enough of the right type of lubricant automatically to every point that requires lubrication.

Manzels save the initial cost many times over each year ...in labor, in oil consumption, and in longer lasting equipment on most of the leading engines, compressors, pumps, presses and other heavy machinery. Or they can be installed on your present equipment.

A Manzel engineer will gladly give you technical assistance on your lubrication problems. Write us now.

Manzel Inc. now supplies repair parts for all models of Bowser and Torrington Lubricators.

Builders of HIGH PRESSURE METERING PUMPS Since 1898

Manzel INC.

273 Babcock St.
Buffalo 10, N. Y.

with present packings. Development of Hydrolube U-4 is now underway to improve the freezing point, V.I., and antiwear properties. Both chlorinated fluids will require the development of new packing materials for hydraulic use, the problem being more difficult for the chlorinated aromatic type. A bibliography is included.

Vol. 6, No. 1, February, 1950

EFFECTIVENESS OF MIST LUBRICATING AND COOLING SYSTEMS
Chamberland, H. J.—pp. 21-22, 36

The author discusses two new lubrication techniques, viz., mist lubrication as applied to sawbands and mist or "cool" system for precision surface grinding. The advantages of spray lubrication and the conditions at which its effectiveness is at its best, are discussed.

NEW COOLANT FOR GRINDING
Anon.—p. 28

Safco 770 Compound with a consistency of liquid paste, is recommended by the manufacturer (Swan-Finch Oil Corp., New York 20, N. Y.) as an all-purpose coolant base for both grinding and machining operations, combining in a single water-soluble product all of the essential qualities of a grinding compound and a sulfurized cutting oil. It is claimed that this compound exhibits the same fine lubricating and anti-weld properties of sulfurized oils — without smoke, odor, dermatitis or burnt hands. Literature is available on request.

Mechanical Engineering, Vol. 72, No. 2, February, 1950

HOUSINGS AND SPINDLES FOR ANTIFRICTION BEARINGS
Blood, H. L.—pp. 131-133
SELECTING ANTIFRICTION BEARINGS FOR MACHINE TOOLS
Baninger, J. H.—pp. 134-136
CHARACTERISTICS OF GREASES AS RELATED TO ANTIFRICTION BEARING APPLICATIONS
Carmichael, E. S., and Robinson, R. C.—pp. 137-141, 143-144
MAINTENANCE OF ANTIFRICTION BEARINGS
Bruening, J. M.—pp. 142-143

These four papers were presented at the Annual Meeting, New York, N. Y., November 27-December 2, 1949, of The American Society of Mechanical Engineers. First paper discusses some important points to be considered in the application of anti-friction bearings, including deflection of spindle and bearings, shaft and housing tolerances for roller bearings, and spindle and housing tolerances for ball bearings. Second paper deals with the selection of one of the three types of antifriction bearings (ball, straight roller and tapered roller bearings) for machine tools. The third paper discusses the characteristics of greases that should be considered in antifriction-bearing applications, viz., consistency, apparent viscosity, structural stability at elevated temperatures, resistance against separation of oil, chemical stability, water-resistance and rust-preventive properties, and film strength. The last paper takes up the maintenance of antifriction bearings.

Petroleum, Vol. 13, No. 3, March, 1950

RE-REFINING OR RECLAIMING?
Anon.—p. 56

Re-refining and reclaiming are two terms for recovering used oil products for further use. These terms have often been used interchangeably in the past, but the respective merits of the processes are so different that a distinction in the

(*Continued on page* 187)

Now—One grease will service all grease applications in the majority of plants

Gives ALL THESE PLANT SAVINGS:

1. **Extends TIME between greasings**—lasts longer . . . stays in bearings longer.
2. **Low-cost application**—fewer servicings and *only the one grease* to handle.
3. **Simple inventory**—Shell Alvania Grease replaces up to 20 brands formerly required.
4. **Better protection**—against heat, cold and moisture.
5. **Greater safety**—less chance of applying the wrong grease!

Gives ALL THESE LUBRICATION ADVANTAGES:

1. **Higher mechanical stability** than any conventional grease at operating temperatures.
2. **Pumpable at low temperatures**—even in unheated storage.
3. **Stable at high temperatures**—superior to the best "soda" greases.
4. **Impervious to water**—excellent resistance to washing out.
5. **Longer service life**—reduced consumption.

The "MILLION-STROKE" Industrial Grease!

A grease that will stand 100,000 punishing strokes of the ASTM Work Tester has been considered a superior lubricant.

In a deliberate attempt to break down Shell Alvania Grease, *on the same tester* the run was extended...200,000 strokes...300,000 strokes . . . 500,000 strokes! Finally, at one million strokes the test was discontinued, because this grease *would not break down*—it was still a fit lubricant both in appearance and consistency.

SHELL OIL COMPANY

50 West 50 Street, New York 20, N. Y. • 100 Bush Street, San Francisco 6, California

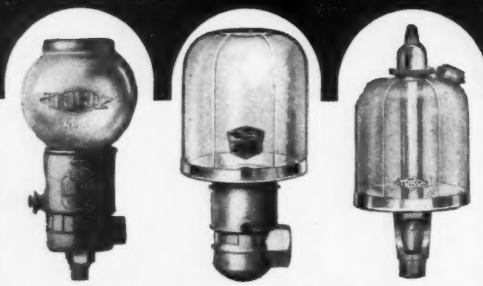
SHELL®

SHELL ALVANIA . . . The "MILLION STROKE" Grease

—Engineered For "TOP" Efficiency!
—Designed For Bearing Safety!

TRICO

VISIBLE-AUTOMATIC
OILERS



With TRICO Oilers installed, you can be SURE your machines are scientifically protected in every way against bearing failures caused by "trust-to-luck" hand oiling, thereby creating COMPLETE customer satisfaction — plus, added prestige — plus, sales appeal.

GIVE YOUR MACHINES THESE TRICO "PROVED-IN-USE" ADVANTAGES . . .

- *Savings In Power-Labor-Lubricants*
- *Greater Production & Machine Life*
- *Minimum Repairs & Maintenance*
- *Modern, Streamlined Design*
- *Less Fire & Accident Hazards*
- *Years of Trouble-free Service*

WRITE FOR FREE CATALOG

TRICO FUSE MFG. CO. Milwaukee, Wis.

PETROLEUM-TYPE HYDRAULIC FLUIDS

Second in the Series
of
A.S.L.E. Monographs

NOW AVAILABLE
$1.00 POST PAID

A.S.L.E.—343 S. Dearborn St., Chicago 4, Ill.

Oils and Lubricants Patent Abstracts

(*Continued from page* 178)

Lubricant—Patent #2,512,784—David E. Adelson, assignor to Shell Development Co.

A lubricant comprising a major proportion of a mineral lubricating oil and a minor amount, but sufficient to stabilize said mineral oil against deterioration and improve its anti-wear properties, of a stable, non-corrosive organic reaction product substantially free from nitrogen obtained by reacting for an extended period of time and at between about room temperature and about 100 C. ammonium hydrosulfide-hydrogen sulfide with an oxygen-containing organic compound until from 4% to about 26.4% sulfur enters the reaction product.

Lubricant Compositions Containing Organic Oxidized and Sulfurized Esters — Patent #2,513,060 — Herschel G. Smith, Troy L. Cantrell, and John G. Peters, assignors to Gulf Oil Corp.

The method of preparing an oxidized sulfurized fatty mono-ester which comprises oxidizing to an iodine number not below about 50 a fatty oil containing glycerides of unsaturated fatty acids and having an iodine number above about 70, reacting the oxidized fatty oil with sulfur to sulfurize the same, subjecting the oxidized sulfurized fatty oil to alcoholysis with a monohydric alcohol in the presence of an alcoholysis catalyst to liberate completely the glycerine from the oxidized sulfurized glycerides and to form the esters of said alcohol and the liberated oxidized sulfurized fatty acids and separately recovering the esters and glycerine so obtained.

Antioxidants for Mineral Oil Lubricants and Compositions Containing the Same — Patent #2,513,061—Herschel G. Smith, Troy L. Cantrell, John G. Peters, assignors to Gulf Oil Corp.

The process of preparing an addition agent for mineral oil lubricants which comprises heating from 1 to 4 mols of benzaldehyde, 1 to 4 mols of N-dimethylaniline and 0.5 to 4 mols of formaldehyde per mol of benzaldehyde in the presence of an activated clay catalyst at a temperature not in excess of 350 F. to condense together the three reactants, and recovering the condensation product.

Antioxidants for Mineral Oil Lubricants and Compositions Containing the Same — Patent #2,513,062—Herschel G. Smith, Troy L. Cantrell, and John G. Peters, assignors to Gulf Oil Corp.

The process of preparing an addition agent for mineral oil lubricants which comprises heating diethylaminobenzaldehyde with from 1 to 4 mols of N-dimethylaniline and 1 to 4 mols of formaldehyde per mol of diethylaminobenzaldehyde in the presence of an activated clay catalyst at a temperature not in excess of 350 F. to condense together the three reactants, and recovering the condensation product.

Grafo **COLLOIDAL GRAPHITE**

INDUSTRIAL PRODUCTION

for—HOT or COLD FORGING, DRAWING AND STAMPING • ASSEMBLY and RUN-IN • HIGH and LOW TEMPERATURES • IMPREGNATION and PARTING • ALL RUBBING and SLIDING SURFACES.

"Grafo" Colloidal Graphite may be obtained in water, petroleum oil and castor oil, in concentrated, semi-concentrated and ready-for-use mediums.

Write Us Regarding Your Special Applications

PRODUCE MORE—FASTER—BETTER

GRAFO COLLOIDS CORPORATION

Other Industrial Uses:
DIE CASTINGS
MOLD COATINGS
STEAM CYLINDERS
WIRE DRAWING
PARTING COMPOUNDS
IMPREGNATION
PLASTICS
CORROSION RETARDANT
RESISTANCE ELEMENTS
STATIC CONTROL
CONDUCTIVE COATINGS
EXTREME PRESSURES

360 WILKES PLACE
SHARON, PENNSYLVANIA

(*Continued from page* 184)

meaning of the words is now urged by the companies concerned. The process of reclaiming usually involves the removal of visible impurities by filtration or centrifuging. Re-refining, on the other hand, restores used oils to their correct specifications by fractional distillation which yields products of the proper viscosity for maximum lubrication.

14.064 1.01

Vol. 13, No. 4, April, 1950

SOLUBLE CUTTING OIL
Anon.—p. 98

A soluble cutting oil which is said to possess extreme pressure properties, known as Supramor Galactol E. P., has recently been marketed in Great Britain. The new product has been developed to meet the problems relating to the difficult alloys which are essential for the modern internal combustion engine and the gas turbine.

14.066

LUBRICANT TESTER
Anon.—p. 99

Development of an apparatus for studying the corrosion characteristics, oxidation stability, and the varnish and sludge formation tendencies of lubricating oil has recently been announced. The apparatus and procedure of testing are described briefly.

18.00 48.037 14.061 16.06

LUBRICATION PHYSICS CONFERENCE
Anon.—p. 104

A joint conference on the physics of lubrication has been organized by the Manchester and District Branch of the Institute of Physics and by the British Rheologists' Club, and will be held in the Physics Department, University of Manchester, from June 29 to July 1, 1950. It is intended to devote sessions to fluid-film lubrication, boundary and extreme pressure lubrication and the physics of lubricants.

Petroleum Processing, Vol. 3, No. 12, December, 1949

SOAP AS A LUBRICANT
Boner, C. J.—pp. 1193-1194, 1196

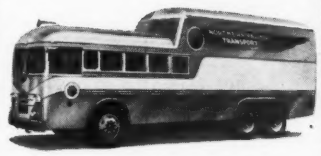
Experimental work and theory are presented to justify the conclusion that the soap in lubricating greases is a primary lubricant, rather than merely a thickener for the mineral oil. This is due to the bonding to the bearing metal of certain types of soap molecules which separate out of the grease to form a monomolecular film which clings to the bearing surface long after a hydrodynamic film has been squeezed out. The physical state of the soap and its dispersion in the mineral oil have an important effect on this lubricating characteristic. This theory of the mechanism of grease lubrication would call for changes in currently accepted specifications.

Vol. 4, No. 10, October, 1949

WORLD-WIDE LUBE OIL CAPACITY AND DEMAND
Keyser, P. V., Jr.—pp. 1091-1093

The paper was presented at the recent meeting of the National Petroleum Association in Atlantic City, New Jersey, September 14-16, 1949. The author states that world capacity to produce lubricating oils is being expanded at such a rate that it will exceed world demand for many years to come. Increases in foreign capacity are just about keeping pace with in-

(*Continued on page* 190)



THE NORTHERN PACIFIC TRANSPORT COMPANY

. . . a very prominent western transportation company, operates a large number of motorized vehicles in the states of Montana and Washington. The operation of their equipment is extremely severe due to mountain grades and wide temperature variations.

They say . . . "THIS LUBRICANT CUT OUR PARTS REPLACEMENT 50%"

Quoting from their letter of October 17, 1949:

"We ran our first test on LUBRIPLATE #22 in March, 1945, in 3000 series Timken tandem-drive, worm axles. That year we experienced considerable trouble with wartime drivers and very poor roads, causing us no end of trouble. The oil that we were using set up to tar in 10 to 15 thousand miles. The LUBRIPLATE #22 proved so satisfactory we installed it in all our worm-gear, hypoid, and two speed axles. This enabled us to change our oil-change period from 15,000 miles to 40,000 and on some applications, depending on speeds and temperatures encountered, we raised the change period to 60,000 miles, or approximately once a year. Our overhaul periods were stretched from 50,000 to 100,000 miles, and repair parts bill cut 50% with the increased mileage."

Naturally with the economies that this company enjoyed through the use of LUBRIPLATE Lubricants on worm-axles, they extended the use of LUBRIPLATE to other parts of their equipment. The savings in parts, time, money and increased efficiency are equally startling. Let us send you the entire report of where they are now using LUBRIPLATE and what it is saving them.

LUBRIPLATE Lubricants will prove just as effective for you in your plant in reducing friction and wear. They are different from any other lubricants you have ever used. They save power, prevent rust and corrosion and definitely arrest progressive wear.

LUBRIPLATE Lubricants are available from the lightest fluids to the heaviest density greases. There is a LUBRIPLATE Product best for your every lubrication requirement. Let us send you CASE HISTORIES of savings that others in your industry are making through the use of LUBRIPLATE Lubricants. Write today.

LUBRIPLATE DIVISION
Fiske Brothers Refining Company
Newark 5, N. J. Toledo 5, Ohio

DEALERS EVERYWHERE . . . CONSULT YOUR CLASSIFIED TELEPHONE BOOK

LUBRIPLATE — THE MODERN LUBRICANT

A.S.L.E. Section Officers

Baltimore:
Chair., W. C. Kesler, Crown Cork & Seal Co., Inc., Eastern Ave. and Kresson St., Baltimore, Md.
V. Chair., W. C. Bauer, Briggs Filtration Co., *119 W. Woodbine St., Chevy Chase 15, Md.
Secy.-Treas., Edward Stoltz, Jr., Johns-Manville Sales Corp., 1312 Standard Oil Bldg., Baltimore 2, Md.

Boston:
Chair., A. E. Baker, Jr., Thomson Laboratory, General Electric Co., River Works, 920 Western Ave., West Lynn 3, Mass.
V. Chair., R. E. Scully, Grinnel Corp., 1 Fenner St., Cranston, R. I.
Secy., Leroy S. Harris, Shell Oil Co., Inc., *300 Edgehill Rd., Milton 86, Mass.
Treas., E. M. Higgins, Master Lubricants Co., *98 Lovell Road, Watertown, Mass.

Buffalo:
Chair., George Findlay, Republic Steel Corp., 1175 South Park Ave., Buffalo 20, N. Y.
Co-Chair., (U.S.A.), Melville Ehrlich, American Lubricants, Inc., 1575 Clinton St., Buffalo 6, N. Y.
Co-Chair., (Canada), A. M. Fowler, Imperial Oil, Ltd., 56 Church St., Toronto, Ontario, Canada.
Secy., Aubrey Brownell, Bethlehem Steel Co., *210 Buffalo St., Hamburg, N. Y.
Treas., J. W. John, Jr., Eastman Kodak Co., Kodak Park, Rochester, N. Y.

Chicago:
Chair., J. J. Slomer, Goodman Mfg. Co., *7416 Bennett Ave., Chicago 49, Ill.
V. Chair., L. B. Burt, Lincoln Engineering Co., *8022 S. Drexel Ave., Chicago 19, Ill.
Secy.-Treas., R. W. Regan, Sun Oil Co., 310 S. Michigan Ave., Chicago 4, Ill.

Cincinnati:
Chair., M. E. Merchant, The Cincinnati Mill. Mach. Co., Research Dept., Cincinnati 9, Ohio.
V. Chair., C. E. Gruen, Shell Oil Co., *6246 Elbrook Ave., Cincinnati 29, Ohio.
Secy.-Treas., W. H. Cornelius, Newport Steel Corp., *50 McAlpin Ave., Erlanger, Ky.

Cleveland:
Chair., C. R. Schmitt, E. F. Houghton & Co., 4500 Euclid Ave., Cleveland 3, Ohio.
V. Chair., N. I. Whiteley, American Steel & Wire Co., *13303 Merl Ave., Lakewood 7, Ohio.
Secy., O. J. Riss, Cleveland Graphite Bronze Co., *62 Stevens Blvd., Willoughby, Ohio.
Treas., A. Nicol, The Ferro Enamel Corp., 4150 E. 56th St., Cleveland 5, Ohio.

Connecticut:
Chair., C. A. Pethybridge, New Britain Machine Co., *107 Pendleton Road, New Britain, Conn.
V. Chair., A. F. Green, Farval Corp., 62 La Salle Road, Hartford 7, Conn.
Secy.-Treas., D. H. Van Vleck, Cuno Engineering Co., 80 S. Vine St., Meriden, Conn.

Dayton:
Chair., E. M. Glass, Hq. Air Material Command, AAF, *128 River Bend, Dayton 5, Ohio.
V. Chair., W. M. Schuck, Armco Steel Corp., General Office, Middletown, Ohio.
Secy., V. C. Hutton, Delco Prod. Div., General Motors Corp., 329 E. First St., Dayton, Ohio.
Treas., J. M. Butler, Monsanto Chemical Co., Nicholas Rd., Dayton 7, Ohio.

Detroit:
Chair., E. S. Kelly, The Budd Co., 12141 Charlevoix Ave., Detroit 14, Mich.
V. Chair., M. B. Lawton, Lincoln Engineering Co., 8627 Woodward Ave., Detroit 2, Mich.
Secy., J. W. Swain, Jr., Mergraf Oil Products Co., Inc., P. O. Box 95, Northville, Mich.
Treas., J. W. Hopkinson, Penn-Petroleum Corp., 7131 Westfield Ave., Detroit 4, Mich.

Evansville:
Chair., R. C. Garretson, International Harvester Co., U. S. Highway No. 41, Evansville, Ind.
Secy.-Treas., W. C. Kerney, Shell Oil Co., 2630 Broadway, Evansville, Ind.

Fort Wayne:
Chair., J. W. Buckner, General Electric Co., *205 East Wabash St., Bluffton, Ind.
V. Chair., Paul E. Bundy, Salisbury Axle Co., Fort Wayne, Ind.
Secy.-Treas., Dean V. Wills, Standard Oil Co. (Ind.) *3715 Hiawatha Blvd., Fort Wayne 6, Ind.

Indianapolis:
Chair., F. H. Bassett, Socony-Vacuum Oil Co., Inc., *R. R. #1, Carmel, Ind.
V. Chair., A. D. Mook, Aluminum Co. of America, Lafayette, Ind.
Secy-Treas., R. C. Fatout, Alvord Oil Co., 1501 S. Senate, Indianapolis 2, Ind.

A.S.L.E. NATIONAL COMMITTEE CHAIRMEN

Awards:
D. N. EVANS
Inland Steel Co.
By-Laws:
H. E. MAHNCKE
Westinghouse Electric Corp.
Education and Training:
D. D. FULLER
Columbia University
Finance:
O. L. MAAG
Chairman Ex-Officio
Timken Roller Bearing Co.
L. B. BURT
Co-Chairman
Lincoln Engineering Co.
General Technical:
M. E. MERCHANT
Cincinnati Milling Machine Co.
Historian:
W. G. FATCH
Carnegie-Illinois Steel Corp.
Individual Membership:
J. W. HOPKINSON
Penn-Petroleum Corp.
Industrial Membership:
W. F. LEONARD
National Office
Industrial Relations:
HENRY MULLER
Shell Oil Co., Inc.
New Sections:
W. F. LEONARD
National Office
Nominations:
C. L. POPE
Eastman Kodak Co.
Program:
Co-Chairmen
J. C. VAN GUNDY
The Texas Co.
M. A. DEWEY
E. I. Dupont de Nemours & Co., Inc.
Research and Projects:
E. M. KIPP
Aluminum Co. of America

Membership in the Society is in several grades as defined below. Assignment to grade is made by the Admissions Committee or Board of Directors on the basis of information submitted or supplied by references.

MEMBERS—$12.50

Members shall be: (1) persons not less than twenty-four years in age who are engaged in research and instruction at technical schools, universities and various publicly and privately supported institutions in the field of lubrication: or (2) persons not less than twenty-four years in age who have occupied recognized positions as Lubrication Engineers for a period of three or more (not necessarily consecutive) years prior to date of admission, involving the responsibility for or supervision of the development, selection, field use and application of lubricants as differentiated from other activities; or (3) persons not less than twenty-four years in age who are indirectly concerned with the field of lubrication, but possessing other qualifications of experience, knowledge and accomplishment, have manifested a particular interest in the purposes and welfare of the Society, to the extent that their membership would be a valuable contribution to the successful functioning of its activities.

JUNIOR MEMBERS—$6.25

Junior Members shall be: persons less than twenty-four years in age, and those who do not completely fulfill the membership requirements for Members.

INDUSTRIAL MEMBERS

Industrial members are such persons or organizations as may be interested in and desire to contribute to supporting the purposes and activities of the Society. The fees paid by an industrial member in general will not be allowed to exceed $200.00 per year.

Kingsport:	Chair., W. S. Moorehouse, Tennessee Eastman Corp., Kingsport, Tenn. V. Chair., M. Ford Supy, Kingsport Press, Inc., *902 Broad St., Apt. 3, Kingsport, Tenn. Secy.-Treas., B. H. Jorgenson, Tennessee Eastman Corp., Kingsport, Tenn.
Los Angeles:	Chair., J. W. Frier, Alemite Co. of Southern California, *2316 S. 3rd Ave., Arcadia, Cal. V. Chair., E. E. Perso, The Texas Co., *1148 N. Jackson, Glendale 7, Cal. Secy.-Treas., F. H. Ott, Union Oil Co. of California, *428 Woodruff Ave., Arcadia, Cal.
Milwaukee:	Chair., R. D. Bussard, Ladish Co., 5481 S. Packard Ave., Cudahy, Wisc. V. Chair., V. A. Weiss, Allis-Chalmers Mfg. Co., *746 S. 26th St., Milwaukee 4, Wisc. Secy., R. G. Cassidy, Filmite Oil Corp., Station "K", Milwaukee 10, Wisc. Treas., J. C. Dawson, Pate Oil Co., *2912 N. 37th St., Milwaukee 10, Wisc.
New York:	Chair., E. M. May, Bowser, Inc., 420 Lexington Ave., New York 17, N. Y. V. Chair., Henry Muller, Shell Oil Co., Inc., *318 W. 106th St., New York 25, N. Y. Secy., D. B. Gordon, Socony-Vacuum Oil Co., Inc., 230 Park Ave., New York 17, N. Y. Treas., Frank Hardy, Bell Telephone Laboratories, 463 West St., New York 14, N. Y.
Northern California:	Chair., A. S. Horwitz, E. F. Houghton & Co., Quint & Davidson Sts., San Francisco, Cal. V. Chair., F. R. Hatch, Shell Oil Co., Inc., 100 Bush St., San Francisco 6, Cal. Secy.-Treas., R. W. Young, Jr., Union Oil Co. of California, 1400 Powell St., Emeryville, Cal.
Philadelphia:	Chair., M. E. Dougherty, Acheson Colloids Corp., 1423 Land Title Bldg., Philadelphia 10, Pa. V. Chair., M. S. Terwilliger, Shell Oil Co., Inc., 12 S. 12th St., Philadelphia 20, Pa. Secy., W. Eismann, Jr., E. F. Houghton & Co., *512 Hunters Lane, Whitemarsh Downs, Oreland, Pa. Treas., S. F. Wedemeyer, Esso Standard Oil Co., *6309 Browning Rd., Merchantville, N. J.
Pittsburgh:	Chair., George L. Sumner, Jr., Gulf Research & Development Co., P. O. Box 2038, Pittsburgh 30, Pa. V. Chair., J. I. C. Taylor, Sun Oil Co., *807 Heberton St., Pittsburgh 6, Pa. Secy.-Treas., George W. Semler, Standard Oil Co. of Pa., *Apt. A-1, 125 Baywood Ave., Mt. Lebanon 16, Pa.
St. Louis:	Chair., Otto Wulfert, Wagner Electric Corp., 6400 Plymouth Ave., St. Louis 14, Missouri. V. Chair., Lewis R. Tharp, E. F. Houghton & Co., Cabanne Station, Box 1806, St. Louis 12, Missouri. Secy., James B. Davis, Monsanto Chemical Co., 1700 So. Second St., St. Louis 4, Missouri. Treas., Michael J. Croghan, Jr., Lincoln Engineering Co., 5701 Natural Bridge Ave., St. Louis 20, Missouri.
Twin Cities:	Chair., E. H. Lindemann, Minneapolis-Honeywell Regulator Co., 2753 4th Ave., South, Minneapolis, Minn. V. Chair., C. K. Olson, Standard Oil Co., *2711 Garfield St., N. E., Minneapolis 18, Minn. Secy.-Treas., J. R. Ritchie, Jr., Ritchie Engineering Co., 3509 Irving Ave., South, Minneapolis 8, Minn.
Youngstown:	Chair., C. M. Winn, Carnegie-Illinois Steel Corp., Salt Springs Road, Youngstown, Ohio. V. Chair., C. T. Lewis, Republic Steel Corp. Secy., M. C. Jones, Youngstown Sheet & Tube Co., *3401 Idle Wood Ave., Youngstown, Ohio. Treas., H. J. Hagan, Republic Steel Corp., *594 Cohasset Drive, Youngstown 7, Ohio.

*Denotes Residence Address Preferred.

PERSONALS

Wheeling Steel Announces: Wheeling Steel Corp., Wheeling, W. Va.—Mr. J. D. Lykins has been promoted to Chief Lubrication Engineer for the above company. He has been and is, one of the most active supporters of A.S.L.E. and his experience is a valuable contribution to the Pittsburgh Section and the Society. Mr. E. C. Milhorn has replaced Mr. Lykins as Lubrication and Mechanical Engineer at the Yorkville, Ohio Works. Appointment of Mr. J. B. Clark as Lubrication Engineer has also been announced.

THERE IS ONLY ONE KINGSPORT*

Kingsport, a city of diversified industry, traces its history back to Revolutionary War days. However, the townsite was not laid out until 1915 and during World War I the present city got its real start.

Dr. John Nolen, famous city planner of Cambridge, Mass., was engaged to develop a plan for the city. The Rockefeller Foundation advised on the city-manager form of government.

Industries, such as Tennessee Eastman Corp. (a subsidiary of Eastman Kodak Co.), Blue Ridge Glass Corp., Kingsport Press, Inc., Borden Mills, Inc., Mead Corp., Kingsport Foundry Mfg. Corp., and others are representative of the diversification that is found in this area.

A "planned community" geographically, politically, physically and spiritually.

* The Kingsport Chamber of Commerce claims that "Of the thousands of post offices and railroad stations listed in official directories, 'There is only one Kingsport.' "

News of the Sections

(*Continued from page* 175)

BUFFALO

"Grease and Its Applications" was discussed by Mr. McConville of the General Electric Co. at the May meeting. This was an excellent opportunity to get the answers to the many questions that were presented on grease and grease applications.

PHILADELPHIA

The final technical meeting of the 1949-50 season was held on May 11th, at which time new Officers were elected to serve for the coming year. (See Section Officers' page.) The second question and answer program of the year was run off under the capable handling of Mr. John Dunigan, SKF, as chief moderator.

On June 16th, this Section held its first outing at the LuLu Country Club. Its success presages an annual repetition.

In this plant Honan-Crane Purifiers are direct connected to twenty-four 1,000 HP Cooper-Bessemers; nineteen 1,000 HP Worthingtons and eleven 1,450 Rathburn Jones engines . . . a total of 68,950 HP.

Honan-Crane Purifiers are available with both single and multiple cartridge-type, quick-change refills . . . using either cellulose fiber, or fullers earth purifying media.

Oil Purification for DIESELS

Proven Design Increases Safe-Use Life of Oil... Cuts Maintenance Costs

Honan-Crane Oil Purifiers are the choice of leading Diesel operators and engineers for purification of lubrication oils in Diesel Engines.

Honan-Crane's purifiers remove abrasives, acids, sludges and all other types of damaging contamination . . . give maximum protection against bearing failure . . . extend safe-use life of oil, thereby reducing the need for frequent oil changes. Design characteristics of Honan-Crane Purifiers have been tested thoroughly for many years under all kinds of operating conditions.

On-the-job performance has proved that the *best* saves you *most* in the long run. Give your diesels the finest protection you can buy . . . specify HONAN-CRANE.

For complete information (or, a Honan-Crane resident engineer will call at your request) . . . write to Honan-Crane, 818 Wabash Avenue, Lebanon, Ind.

HONAN-CRANE CORP., Lebanon, Indiana

Subsidiary of **HOUDAILLE-HERSHEY CORP.**

(*Continued from page* 187)

creases in foreign demand, indicating that for some years the U. S. will continue to be the country with the greatest surplus of capacity over demand. Lubricating oil production facilities in the U. S., therefore, will operate considerably below capacity, with curtailments being made in the conventional type operations rather than the solvent refining plants.

SULFURIZED EXTREME-PRESSURE LUBRICANTS AND CUTTING OILS. PART 2, PATENT SURVEY
Sellei, H.—pp. 1116-1120

This paper is a survey on the general subject of sulfurized oils and sulfur compounds, with particular reference to the use of such materials in extreme pressure lubricants and cutting oils. Part 1, published in September, 1949, issue, pp. 1003-1008, covered the important contributions published in the English language up to 1948, with a few pertinent references from the foreign literature. Part 2, printed this month, covers U.S. patents on the subject. The summary of the first part is included.

Petroleum World, Vol. 46, No. 10, October, 1949

NEW "SELF THINKING" ENERGIZABLE VALVE LUBRICANT
Anon.—pp. 32-34

The article refers to the energizable "self-thinking" valve lubricant that provides fully automatic lubrication. Energized feature of the "Hypermatic" (as the lubricant is named) is explained. Demonstration of comparative action of non-energizable and Hypermatic energized lubricant in similar valves is described. Hypermatic is developed by George F. Scherer, director of research of the Nordstrom Valve Division, Rockwell Manufacturing Company. See also *World Oil*. Vol. 129, No. 7, October, 1949, pp. 201-203.

Power, Vol. 94, No. 3, March, 1950

OIL LUBRICATION OF ANTIFRICTION BEARINGS
Anon.—pp. 91-93

Oiling of ball and roller bearings is discussed, with a few tips on what applications are best handled with oil rather than grease. An outline is presented on applications for oil lubrication of antifriction bearings. Eight causes of an early bearing failure are indicated.

21.00 14.61 14.063

Revue de L'Institut Francais Du Petrole et Annales Des Combustibles Liquides, Vol. 4, No. 11, November, 1949

LUBRICANTS ARE GOING BACK
Anon.—pp. D-124—D-125
(Petr. Press Serv., Vol. 16, No. 6, June, 1949, pp. 153-157)

A table gives availability of and demand for lubricants in the U.S.A. in 1939-1948. Beginning from December, 1948, prices for lubricants and Pennsylvania crude are declining. Right after the war the prices were increased considerably due to the necessity of replenishing the stocks. Now the consumption of lubricants is slowed down 1) due to the reduction of industrial activities and 2) due to the improvement of the quality of lubricating oils and of lubricating technique. Refineries attempted to adjust the production to the decreased demand by decreasing the proportion of lubricants to the total refined products by 2.5-2.9%.

Scientific Lubrication, Vol. 1, No. 7, November, 1949

FIRST PRINCIPLES. A SERIES OF ARTICLES EXPLAINING IN SIMPLE LANGUAGE THE FUNDAMENTALS OF LUBRICATION. No. 7. LAWS OF FRICTION
Anon.—pp. 14-15

Friction that occurs between clean, dry and unlubricated surfaces obeys certain rules which enable one to calculate, for example, the power required to move a weight along an unlubricated surface, or to drive any piece of unlubricated machinery. The reader will never be likely to want to do this, but these rules should be known to all students of lubrication. The laws of solid friction are given. Fluid frictional resistance is dependent upon the speed of running between the surfaces. When fluid separates the moving surfaces, friction can only be generated by the shearing of this fluid. Therefore, the faster the fluid film is sheared, the more friction generated and the more work or energy that must be expended to secure relative movement of the surfaces. Laws are taken up. It is impossible to define any laws for boundary friction which is a combination of solid and fluid friction. Greasy surfaces are subjected to boundary conditions of lubrication because the surfaces are only partly separated by the lubricant. Rolling friction occurs in anti-friction bearings. Theoretically, ball bearings should only have point contact between balls and races, roller bearings should only have line contact. Rolling friction is a form of solid friction, and obeys the same rules, although when lubricated, boundary conditions prevail, with occasional fluid friction.

SOLVE 9 *Lubrication Problems*

WITH *Norgren* OIL-FOG LUBRICATORS

1—Simply oil the air that drives the equipment.
2—Eliminate human element except for refilling the lubricator.
3—Oil fog means more positive, thorough lubrication.
4—Feed controlled, correct amount of fresh, clean lubricant.
5—Lubricate only when equipment operates.
6—Stop corrosion when equipment is idle.
7—Nothing to turn on or off.
8—Stop oil waste.
9—Reduce lubrication costs.

Write for the many worthwhile details:
C. A. Norgren Co., 222 Santa Fe Drive, Denver 9, Colo.

Lubricators, Filters, Regulators, Air Controls, Valves, Hose Assemblies.

Norgren

PROPERTIES AND USES OF A NEW SERIES OF LUBRICANTS
Anon.—pp. 16-17

Recent years have seen the introduction by the Dow Corning Corporation of three silicone greases that have been applied with great success to the lubrication of ball bearings operating at abnormally high and low temperatures. These greases have good heat stability, low volatility and freezing points, while over a wide range of temperature their consistency changes only slightly. General properties are considered.

REVERSING LUBRICATING SYSTEM
Anon.—pp. 18-20

The Trabon system of centralized lubrication has been widely used in the U.S.A. for nineteen years. The principle feature of this system is that it is "reversing," i.e., it is a one-line system and feeds lubricant round the circuit first in one direction and then in the other. The system incorporates a pump and a group of reversing "feeders," one for each lubricating point. The feeders are connected together with a single line of piping to form one continuous circuit. Moving parts are connected to the feeders by means of flexible piping as the article describes hereafter. The lubricant passes through each feeder, in turn, right round the circuit and then it reverses its direction of flow and completes the circuit in the opposite direction.

Vol. 2, No. 1, January, 1950
LABORATORY WEAR TESTS FOR GEAR LUBRICANTS
Anon.—pp. 12-13, 20

The use of the SAE extreme pressure lubricants testing machine for investigating the load-carrying capacity of gear lubricants is well known, but it now finds a new use. There has been a need for a laboratory test to determine wear conditions simulating high torque and low speed. Work has been done in this direction by the National Bureau of Standards, employing a modified SAE testing machine. Details of these modifications and the results obtained are given in this article. Other information includes an indication of run-in-wear, the change in surface roughness of the test cups with wear and the effect of the original surface roughness on the rate of wear.

COLOUR CODES
Harrison, J.—pp. 22-24

One difficulty with factory lubrication is to present instructions to the user in an understandable way. A factory superintendent may understand them but the actual man who does the lubrication may not. Some years ago, having discovered a factory in which the lubrication was undertaken by an old and almost illiterate laborer given an oil can, it was decided that this would provide an ideal works in which to inaugurate a simple method whereby unskilled labor could lubricate machinery with scientific precision. The management welcomed the investigations. Various schemes were investigated. There are two variables that any coding system must fix definitely: (1) The frequency of application. (2) The grade of lubricant. The symbols decided upon were elementary geometric shapes. Colored transfers provide a simple, neat and easy method for fixing the code signs. As a working basis it was decided that the circle should denote daily attention, the triangle weekly attention and the square monthly service. Details are discussed. Generally speaking the older type of laborer, though perhaps harder to teach, is more eager to learn and is more painstaking in execution than a younger man. The method outlined is useful where employment of a full-time service mechanic is not warranted. The routine must be planned so that no machine is overlooked.

Vol. 2, No. 2, February, 1950
SYNTHETIC LUBRICATING OILS
Williams, A. E.—pp. 2-5

Enough work has already been done in Germany and on an experimental scale in England to show that good quality lubricating oils can be produced by polymerizing and refining the products of the Fischer-Tropsch plants. However, cost in England at present is too high, amounting to about four shillings a gallon to get a good grade lubricating oil. At present the cost in the United States is somewhat lower because natural gas is available in abundance as a cheap raw material. Water-gas produced commercially gives a mixture of 40% carbon monoxide and 50% hydrogen. This composition must be altered and this can be done either by adding hydrogen or by removing some of the carbon monoxide. Figure 2 shows the type of reaction plant for the synthesis used in Germany. Aluminum chloride is used as a catalyst to polymerize ethylene and olefines. Good lubricants result, except they do not pass the British Air Ministry specification oxidation number. Three methods to improve this are: distillation, solvent treatment and hydrogenation. Hydrogenation is the most promising.

14.069 28.02

SULPHUR and CHEMICAL *Additives*

MODERN DEVELOPMENTS *for the* PETROLEUM *and* METAL INDUSTRIES

BURNS LABORATORIES INC.
INDIANAPOLIS, INDIANA

Copy of this booklet available upon request.

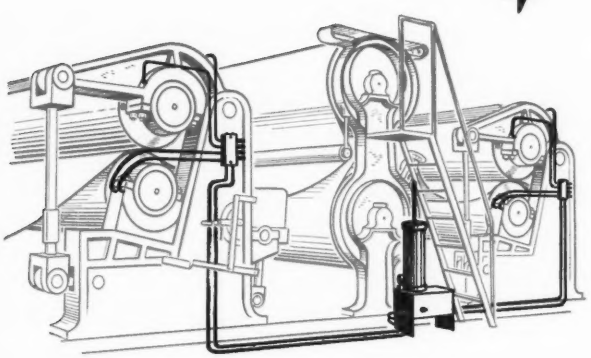
PLEASE TURN TO PAGE 171 FOR NEWS OF THE 1951 ASLE CONVENTION

Advertisers IN THIS ISSUE

Acheson Colloids Corp. 153
Alemite 155
Aro Equipment Corp., The 183
Brooks Oil Co., The 182
Burns Laboratories, Inc. 192
Cincinnati Milling Machine Co. 151
Farval Corp., The ..... Inside Back Cover
Fiske Bros. Ref. Co. (Lubriplate Div.) 187
Frantz, S. G., Co. 181
Gits Bros. Mfg. Co. 180
Grafo Colloids Corp. 186
Hodson Corp., The ..... Back Cover
Honan-Crane Corp. 190
Lincoln Engineering Co. 152
Madison-Kipp Corp. 150
Manzel, Inc. 184
Morgan Construction Co. 154
Norgen, C. A., Co. 191
Shell Oil Co., Inc. 185
Sinclair Refining Co. 180
Stuart, D. A., Oil Co., Ltd. 149
Sun Oil Co. 156
Trabon Engineering Corp. ..... Inside Front Cover
Trico Fuse Mfg. Co. 186
Universal Lubricating Systems, Inc. 182
Warren Refining & Chemical Co., The 179

18% less h.p. load with Farval lubrication

FARVAL—*Studies in Centralized Lubrication* No. 112



IN the manufacture of paper, as the wet pulp travels through the rolls of the Kamyr press, pressures run up to 2700 pounds per inch. Lubrication by hand is usually accompanied by a noticeable power drag. Lubricant is wasted and shutdowns for bearing repair invariably follow.

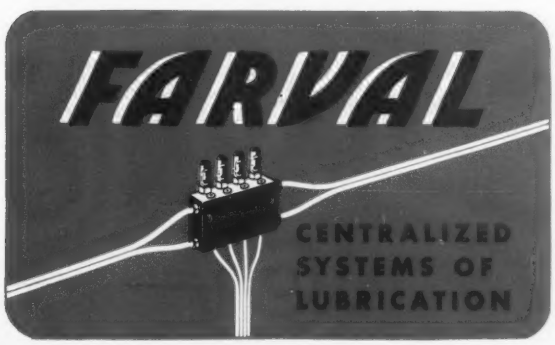
To insure continuous, uniform lubrication of its Kamyr press, a Canadian pulp mill installed Farval Centralized Lubrication. An immediate reduction of bearing friction brought a substantial reduction in power consumption. In fact, recording charts on the press show that when the Farval system was installed the horsepower load dropped as much as 18%.

On these press rolls, as on hundreds of other rolls —calendar stacks in paper mills—rubber mills—steel and brass rolling mills—Farval has proved its ability to save power, oiling labor, lubricant and bearing expense. Most important of all, it reduces downtime and increases production.

Farval has proven itself in over 20 years of service. It is the original Dualine system of centralized lubrication that others imitate. The Farval valve has only 2 moving parts—is simple, sure and foolproof, without springs, ball-checks or pinhole ports to cause trouble. Through its wide valve ports, and full hydraulic operation, Farval unfailingly delivers grease or oil to each bearing—as much as you want, exactly measured—as often as desired. Indicators at every bearing show that each valve has functioned. For a full description, write for Bulletin No. 25.

The Farval Corporation, 3267 East 80th Street, Cleveland 4, Ohio.

Affiliate of The Cleveland Worm & Gear Company, Industrial Worm Gearing. In Canada: Peacock Brothers Limited.



DESIGNED LUBRICATION FOR PRIME DEMANDS

HODSON

"FOUR HORSEMEN®"

DENSOIL

GEARKOTE®

METALICOIL

METALICGREASE

NONSEPARA®

PRODUCTS

25th Year

THE HODSON CORPORATION

Lubrication Engineers and Manufacturers

5301-11 West 66th Street, Chicago 38, Illinois

Printed in U.S.A.